SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE GEOLOGY OF ORE DEPOSITS.

II.

WE have now traced the metals of many ores to their first positions in the veins. In order to understand other cases, we must recall the facts as to the relations of 'richness with depth.' At this point I take my illustrations from regions outside of Colorado. James Douglass says that in the Appalachian region every copper mine has diminished in richness with depth. Near the surface rich oxidized products were found. Near the level of ground-water rich belts of sulphides occurred—in some instances extraordinarily rich. Below the level of rich sulphides every old mine has passed into cupriferous pyrrhotite, a sulphide of iron bearing a very small percentage of copper. In the Sierra Nevadas, of California, Mr. Lindgren states that near the surface the values range from $80 to $300 per ton; but a little way below the level of ground-water these values fall to $20 or $30 per ton, and no exceedingly rich deposits are found. You all know the history of the Comstock lode; and of the great bonanzas found above or about the 2,000-foot level, and which did not extend deeper. In the Lake Superior region the greatest iron-ore mines in the world occur; four-fifths or more of the entire product of iron of the United States comes from that region; but at the present time vastly more

iron has been taken out above the 1,000-foot level than below it. If time sufficed, similar instances from all the old mining regions of the world could be cited.

I by no means assert that the above illustrations represent an invariable rule. Indeed, this is not the case. But the illustrations undoubtedly do represent the average relation of richness and depth.

Now this story is an entirely different one from the illusion of increased richness with depth based upon the supposition that the metals for the ores are derived from the unknown depths of the earth. If that theory be true, it is natural to believe that ore deposits upon the average will become richer with depth. But if it be a pure unverified hypothesis, not supported by any facts, it is of vital importance for practical mining men to know this, since the knowledge will save them vast sums of money expended in exploration under a false theory. So far as I am aware of the facts, I do not know of a mining region in the world which supports the theory of increased richness with depth, if the unit of measure be taken as one thousand feet, if the first thousand feet be compared with the second thousand, and the second thousand with the third, and so on. In fact, nine mines out of ten, taking the world as a whole, are poorer the second thousand feet than they are the first thousand feet, and are poorer the third thousand feet than they are the second thousand feet. Many ore deposits have been exhausted or have become so lean as not to warrant working before the 1,000-foot level is reached; a large proportion before the 2,000-foot level is reached; while comparatively few ore deposits have been found to be so rich as to warrant working at depths greater than 3,000 feet.

There are, however, some ore deposits which are not known to gradually decrease in richness with depth so far as yet exploited. There are a considerable number of deposits which perhaps after a first rapid decrease in richness maintain their tenor pretty well to the depth of 1,000, 2,000 or even 3,000 feet, and some few deposits maintain their richness at even greater depths. But we cannot reasonably hope that a deposit will get richer with depth, provided we use a 1,000-foot unit for measurement. The most sanguine view which is ever justified for any deposit is that, using a 1,000-foot unit, the second shall be as good as the first, and the third as good as the second. While the above is true, there are very great irregularities in the richness of ore deposits, both favorable and unfavorable, due to multifarious causes, which I cannot possibly discuss to-night, but which I considered somewhat fully in my Institute paper.* These irregularities are especially marked in the upper 1,000 feet of a deposit; so that in many cases, if the unit of measurement were 25 feet or 100 feet, or in a few cases 500 feet even, it might be said that deposits are becoming richer with depth; although the reverse also occurs in many cases. The truth is that in the upper parts of ore deposits the variations in richness with depth are extreme, and no definite rules can be laid down in reference to them.

This rule of the diminution of richness with depth is one of averages only when considerable depths are taken into account. The factors entering into the production of an individual ore deposit are so numerous, and the irregularities are so great, that the rule cannot be asserted in advance of development of an individual mine without a study of the conditions there obtaining.

Now what is the explanation of these irregularities and of the very general diminution of richness with depth? What is the

* 'Some Principles controlling the Deposition of Ores,' by C. R. Van Hise: *Trans. Am. Inst. Min. Eng.*, Vol. XXX., 1900, pp. 102–112.

explanation in some cases of the relatively even values at different depths? The last question will be first considered.

In those instances in which the tenor is maintained or practically maintained from the surface to a great depth, the ore is believed to be the result of a single concentration by ascending waters. Such ore deposits may continue without any appreciable diminution in richness to the lowest limits to which man may expect to penetrate the earth; but these are exceptional cases. Even ore deposits which are the result of a single concentration by ascending water may diminish in richness at considerable depth. It has been seen that in the fissure at the bottom of the valley on this chart (Fig. 6) the water ascends to the surface. It is evident that the upper part of the fissure receives the greatest supply of water, and this water to a large extent does not penetrate any great depth; while the lower part of the fissure receives less water, but this water penetrates to a considerable depth. It may happen that the water relatively near the surface traverses the rocks containing the main supply of metals and, therefore, brings the chief contributions of valuable material, or such waters may carry the precipitating agent. In such instances the ore deposits produced by ascending water alone would diminish in richness with depth; but such decrease would not be likely to be very rapid. Upon the other hand, if the above conditions be reversed, a deposit may increase in richness for a considerable depth; but as a matter of fact this appears to be a very infrequent case.

As illustrations of the ore deposits of the class produced by ascending waters alone are the copper deposits of Lake Superior. These deposits, while very bunchy and extremely irregular in the distribution of copper, are wonderfully persistent in depth. The copper of the ore was deposited in the metallic form. As compared with sulphides, this material is not readily oxidized. In this district the rocks above the level of ground-water are not appreciably weathered. Doubtless there was a belt of weathered material before the glacial epochs, but if so, it has been swept away by ice erosion; and since the glacial period sufficient time has not elapsed to weather appreciably the rocks which now lie within the theoretical belt of weathering. If there once were in this district an upper belt of weathering in which there were deposits of exceptional richness, this material has been removed. However, in this district, a first concentration by ascending waters was adequate, but it is not often that a first concentration produces deposits of such richness as those adjacent to Calumet and Houghton on Keweenaw Point; and, indeed, this is exceptional even in the Keweenawan of the Lake Superior region; for while concentrations of copper have occurred at many points in the rocks of this period, as yet at no other locality have those concentrations been found to be so abundant and rich as to warrant exploitation on a large scale.

I now turn to the question as to the cause of frequent diminution of richness of ore deposits with depth. The explanation of the very frequent diminution of value with depth seems to me to lie in the secondary effect of descending currents upon deposits first deposited by ascending waters. Many or most of such ore deposits are believed to be the products of two concentrations, the first by ascending, the second by descending waters. In this connection it is necessary to call attention to the fact that a large proportion of the deposits which are being exploited are below part of a slope. It may be said that the reason for this is that the low grounds are more difficult to explore and work; but giving due allowance for this,

it still seems to me that the majority, perhaps the great majority, of very rich deposits are below slopes and crests, and not below the valleys. I believe the richer deposits are below the slopes, because at these places a second concentration is possible and probable.

Returning now to this chart (Fig. 6), we shall direct our attention to the fissure on the slope. This fissure once extended up through the overlying rocks which have been removed by denudation. What has become of the ore in the part of the fissure which has been worn away? If, for instance, it carried five per cent. of copper, what has become of it? A part of it would have been scattered far and wide througn erosive action; but a part of it would have been taken into solution and redeposited in the same vein deeper down. In the belt of weathering oxidized salts, such as sulphates, would form; the descending waters would carry these products downward; and it is my belief that they would react upon the solid, lean sulphides below with the result of precipitating the metals from the descending solutions. Now this has been held to be a mere unverified assumption by some geologists, but it seems to me that they have not fully considered the certain effects of the chemical laws concerned. We know if in a laboratory a solution of copper sulphate or other copper salt be placed in contact with iron sulphide, that copper will be thrown down as copper sulphide. If the copper solution be placed in contact with a lean copper-iron sulphide, a sulphide richer in copper will be produced. And if these reactions occur in the chemical laboratory, will they not as certainly occur in the laboratory of nature, although perhaps more slowly?

At this point it is to be recalled that in many ore deposits above the level of ground-water oxides and carbonates occur, while below the level of ground-water are sulphides. Moreover, at high levels these sulphides are rich in valuable metals, and usually become poorer in these metals and richer in iron sulphide at the lower levels. You will remember at Butte, Mont., at and for a distance below the level of the ground-water, are rich copper sulphurets which grade at depth into leaner copper sulphides containing correspondingly large amounts of iron sulphide. You will remember the same is true of the entire Appalachian region. You will remember that frequently above the level of the ground-water gold lodes are exceedingly rich. What is the explanation of these similar facts? What is the explanation of the exceptional or even extraordinary richness of the deposits at and near the level of ground-water, and of the low grade of galena, blende or pyrites deep below the level of ground-water? In my opinion the only plausible explanation is that the rich parts of the deposits have received two concentrations, the first by ascending waters and the second by descending waters. The metals of the rich portions of the deposits were largely contributed by the parts of the deposit above, or once above, the rich parts. In some cases portions of the depleted veins remain, as at Butte; but frequently the depleted parts of the veins have been removed by erosion. The remote source of the material was, therefore, the metals deposited by the first concentration. But let us follow the matter still further. In the majority of cases, as denudation continued, the parts of the ore deposits produced by the second concentration rise into the belt of weathering. They may there be partly or wholly transformed into rich oxidized products, or they may be depleted to extend the rich deposits below. In the concentration by descending waters the chief chemical reactions are believed to be between the oxides or salts of the valuable metals and the sulphide of iron; although, of course, similar reactions

occur between the salts of silver and gold and other metals, and the sulphides of lead and zinc.

Time does not permit the consideration of the various reactions which result in the reconcentration by descending waters. These I shall be obliged to take for granted this evening, but those who care to follow the subject further may find a treatment of this part of it in my full paper upon the deposition of ores, published in Volume XXX. of the *Transactions of the American Institute of Mining Engineers.*

During the process of reconcentration erosion steadily goes on, perhaps to a depth of 1,000 or 5,000 or even 10,000 feet, or more. As denudation steadily lowers the surface of the country, the material deposited by the first concentration is picked up and gradually carried down along the vein by the descending waters. This material reacts upon the other materials, and is largely reprecipitated.

In the foregoing statements the second concentration of metals by solution, downward transportation and precipitation by reactions upon the sulphides of an earlier concentration has been emphasized. However, it is not supposed that this is the only process which may result in enrichment of the upper parts of ore deposits by descending waters. The enrichment of this belt may be partly caused (1) by reactions between the downward-moving waters carrying metallic compounds and the rocks with which they come in contact, and (2) by reactions due to the meeting and mingling of the waters from above and the waters from below.

1. The metallic compounds dissolved in the upper parts of the veins, carried by descending water, may be precipitated by material contained in the rocks below. This material may be organic matter, ferrous substances, etc. So far as precipitating materials are reducing agents, they are likely to change the sulphates to sulphides, and precipitate the metals in that form. While sulphides may thus be precipitated either above or below the level of ground water, they are more likely to be thrown down below the level of ground-water. Other compounds than reducing agents or sulphides may precipitate the downward-moving salts in other forms than sulphides.

2. In a trunk-channel, where waters ascending from below meet waters descending from above, there will probably be a considerable belt in which the circulation is slow and irregular, the main current now moving slowly upward and now moving slowly downward, and at all times being disturbed by convectional movements. Doubtless this belt of slow general movement and convectional circulation would reach a lower level at times and places of abundant rainfall than at other times and places, for under such circumstances the descending currents would be strong. The ascending currents, being controlled by the meteoric waters falling over wider areas, and subject to longer journeys than the descending currents, would not so quickly feel the effect of abundant rainfall. Later, the ascending currents might feel the effect of the abundant rainfall and carry the belt of upward movement to a higher level than normal. However, where the circulation is a very deep one, little variation in ascending currents results from irregularities of rainfall.

In the belt of meeting ascending and descending waters (see Fig. 6) convectional mixing of the solutions due to difference in temperature would be an important phenomenon. The waters from above are cool and dense, while those from below are warm and less dense. In the neutral zone of circulation the waters from above would thus tend to sink downward, while waters from below would tend to rise, and thus

the waters would be mingled. Still further, even if the water were supposed to be stagnant at the neutral belt, it is probable that by diffusion the materials contributed by the descending waters would be mingled with the materials contributed by the ascending waters.

Ascending and descending solutions are sure to have widely different compositions, and precipitation of metalliferous ores is a certain result. As a specific case in which precipitation is likely to occur, we may recall that waters ascending from below contain practically no free oxygen and are often somewhat alkaline, while waters descending from above are usually rich in oxygen and frequently contain acids, as at Sulphur Bank, described by Le Conte.* The mingling of such waters as these is almost sure to result in precipitation of some kind. Le Conte further suggests † by the mingling of the waters from below with those from above that the temperature of the ascending column will be rapidly lessened, and this also may result in precipitation.

The metals precipitated by the mingling of the waters may be contributed by the descending waters, by the ascending waters, or partly by each. In so far as more than an average amount of metallic material is precipitated from the ascending waters, this would result in the relatively greater richness of the upper part of veins independently of the material carried down from above.

In all the cases considered the precipitation and enrichment of the upper parts of deposits follow from the reactions of downward-moving waters. Their effect may be to precipitate the metals of the ascending water to some extent, and thus assist in the first concentration. But the results of these processes cannot be discriminated from the concentration resulting from an actual downward transportation of the material of an earlier concentration. In concluding this part of the subject, *it is held that the downward transportation of metals already in lodes is the most important of the causes explaining the character of the upper portions of ore deposits; and that their peculiar characters are certainly due to the effect of descending waters.*

The concentrations by ascending and descending waters have been considered as if they were mainly successive. In some instances this may be the case; but it is much more probable that ascending and descending waters are ordinarily at work upon the same fissure at the same time, and that their products are, to a certain extent, simultaneously deposited. For instance, under the conditions represented by this chart (Fig. 6) a first concentration by ascending waters is taking place in the lower part of the fissure, and a reconcentration by descending waters is taking place in the upper part of the fissure. Between the two there is a belt in which both ascending and descending waters are at work. The rich upper part of an ore deposit which is worked in an individual case may now be in the place where ascending waters alone were first acting, where later, as a consequence of denudation, both ascending and descending waters were at work, and still later, where descending waters alone are at work. The more accurate statement concerning ore deposits produced by ascending and descending waters is, therefore, that ascending waters are likely to be the potent factor in an early stage of the process, that both may work together at an intermediate stage, and that descending waters are likely to be the potent factor in the closing stage of the process.

Also, for the sake of simplicity in the consideration of the concentrations I have

* 'On the Genesis of Metalliferous Veins,' by Joseph Le Conte, *Am. Jour. Sci.*, 3d ser., Vol. XXVI., 1883, p. 9.

† Le Conte, op. cit., p. 12.

disregarded the lateral elements of the moving water. In many cases superimposed upon the vertical movements in the fissures or other openings are lateral movements, as a result of which the deposits, instead of being in vertical positions, are inclined, often much inclined, and indeed may be horizontal. Moreover, the horizontal extents of the deposits may be much greater than the vertical extents. Reduced to a simple and broad statement, *the first concentration of many ore deposits is the work of a relatively deep-water circulation, while the reconcentration is the result of reactions upon an earlier concentration through the agency of a relatively shallow water circulation. Commonly the deep-water circulation is lacking in free oxygen and contains reducing agents, and the shallow water contains free oxygen. The deep water is, therefore, a reducing, and the shallow water an oxidizing agent.*

In addition to the general factors already considered there are many special factors which have a most important, indeed, very often a controlling influence in the production of ore-chutes and in the localization of ore in certain areas and districts. Some of these factors are the complexity of openings, the presence of impervious strata at various depths, the presence of pitching folds, the character of the topography. I see, however, that my time is nearly gone, and I shall not take up their discussion this evening, but must refer those especially interested in this phase of the subject to my full paper already mentioned.* I must, however, note that impervious strata are frequently of controlling importance in the underground circulation. Often deep and shallow water circulations are separated by such strata. Often also, as the result of the removal of impervious strata by denudation, the previous deep circulation ceases and the action of the shallow circulation is inaugurated.

At this point it may be well to briefly recall the most fundamental features of the water circulation which produces the ore deposits. First comes the downward-moving, lateral-moving waters of meteoric origin which take into solution metalliferous material. These waters at depth are converged into trunk channels, and there, while ascending, the first concentration of ore deposits may result. After this first concentration many of the ore deposits which are worked by man have undergone a later concentration, not less important than the earlier, as a result of shallow descending or lateral-moving waters. In other cases, a concentration by descending, lateral-moving waters alone is sufficient to explain some ore deposits. It thus appears more clearly than heretofore that an adequate view of ore deposits must not be a descending-water theory, a lateral-secreting water theory or an ascending-water theory alone. While an individual ore deposit may be produced by one of these processes, *for many ore deposits a satisfactory theory must be a descending, lateral-secreting, ascending, descending, lateral-secreting theory.*

But there is no question in my mind that this theory is still insufficient to fully explain many of the ore deposits. No knowledge is ever complete. We move step by step, carrying a theory nearer and nearer completion. If, however, a theory be based on good work, it usually will not prove to be false; it will be found to be incomplete. Sandberger was not wrong when he said lateral secretion explained many things in reference to ore deposits. He was wrong only when he excluded other factors. He became unscientific when he carried his theory further than his observations justified. While the theory here proposed is believed to make an important advance, it will sooner or later be found to be incom-

* 'Some Principles controlling the Deposition of Ores,' by C. R. Van Hise, *Trans. Am. Inst. Min. Eng.*, Vol. XXX., 1901, pp. 112–146.

plete. I trust it will not be found to be false. But the most that I can hope for it is that it is approximately correct as far as it goes.

It is believed that the principles which have been presented lead to a new and natural classification of the ore deposits produced by underground water. As already noted, ore deposits may be divided into three groups: (1) Ores of igneous origin, (2) ores which are the direct result of the processes of sedimentation, and (3) ores which are deposited by underground water.

Since the ores produced by igneous agencies and those produced by processes of sedimentation have not been considered in this paper, a subdivision of these groups will not be attempted.

Ores resulting from the work of groundwater, group (3) above, may be divided into three main classes:

(*a*) Ores which at the point of precipitation are deposited by ascending waters alone. These ores are usually metallic or some forms of sulphurets; but they may be tellurides, silicates or carbonates.

(*b*) Ores which at the place of precipitation are deposited by descending waters alone. These ores are ordinarily oxides, carbonates, chlorides, etc., but silicates and metals are exceptionally included.

(*c*) Ores which receive a first concentration by ascending waters and a reconcentration by descending waters. The concentration by ascending waters may wholly precede the concentration by descending waters, but often the two processes are at least partly contemporaneous. The materials of class *c* comprise oxides, carbonates, chlorides, and rarely metals and silicates, above the level of groundwater, and rich and poor sulphurets, tellurides, metallic ores, etc., below the level of ground-water. At or near the level of ground-water, these two kinds of products are more or less intermingled, and there is frequently a transition belt of considerable breadth.

How extensive are the deposits of class *a* I shall not attempt to state. Indeed, I have not such familiarity with ore deposits as to entitle me to an opinion upon this point. However, a considerable number of important ore deposits belong to this class. This class is illustrated by the Lake Superior copper deposits.

The ore deposits of class *b* are important. Of the various ores here belonging probably the iron ores are of the most consequence. All of the iron ores of the Lake Superior region now being exploited are of this class.

It is believed that the ore deposits of class *c* are by far the most numerous. I suspect that a close study of ore deposits in reference to their origin will result in the conclusion that the great majority of ores formed by underground water are not the deposits of ascending waters alone, but have by this process undergone an early concentration, and that descending waters have produced a later concentration, as a result of which there is placed in the upper 100 to 1,500 or possibly even 3,000 feet of an ore deposit a large portion of the metalliferous material which originally had, as a result of the early concentration, a much wider vertical distribution.

The depth to which rich deposits of the classes produced or concentrated by descending water extend is a very important question; but time does not permit adequate discussion of it. The factors entering into the problem are very numerous and complicated. Only a single one of these will be briefly considered, and this is the topography. Where the relief is small, the vertical effect of descending solutions extends upon the average to less depths than where the relief is great. But even where the relief is moderate the descending solutions may be effectual to a considerable

depth, as shown by the Lake Superior iron mines. And where the topographic forms are those of great and sharp relief, there the descending waters go to very great depths. In the San Juan region, for instance, are wonderfully steep slopes and very great canyons. Here the water descends a long way on its downward course before it turns laterally and upward on its way to the valleys. I have visited the San Juan region during the past week with other geologists, and in some cases we saw the effect of descending water to a depth of 3,000 feet below the surface. It has already been explained that in the early history of this region the conditions were ideal for a first precipitation of ores by ascending waters. They are now no less ideal for a reconcentration by descending waters.

If the classification advocated be based upon facts, it gives valuable criteria to mining men for the exploration and exploitation of their mines. Many millions of dollars have been lost needlessly in exploitation by not understanding or paying attention to this matter. In many cases it can be ascertained to which of these three classes an ore deposit belongs.

The character of a deposit in most cases will determine this. Where the ores are deposited by ascending waters alone it has been pointed out that this is favorable to their continuity to great depth. Therefore, where a given ore deposit has been shown to belong to this class, the expenditure of money for deep exploration may be warranted, although, as already pointed out, such deposits may decrease in richness with depth. Where a deposit is produced by descending waters alone, the probable extent in depth is much more limited. In such cases, when the bottom of the rich product is reached, it would be the height of folly to expend money in deep exploration. Where the ore deposit belongs to the third class, that produced by ascending and descending waters combined, there will, again, be a richer upper belt composed of rich oxidized and sulphureted deposits which we cannot hope will be duplicated at depth. To illustrate: It would be very foolish, at Ducktown, Tenn., to sink a drill hole or shaft into the lean cupriferous pyrrhotite with the hope of finding rich sulphurets such as those which were mined near the level of groundwater. Those who have spent money in deep prospecting of the lean pyrrhotite in the Appalachian range will doubtless agree to this statement. Deposits produced by two concentrations may grade into the class produced by ascending water alone, and after the transition the deposit may be rich enough to warrant exploitation at depth; but if such work be undertaken it must be done with the understanding that the rich upper products will not be reduplicated at depth. It therefore appears to me that the determination to which of the classes of ore deposits produced by underground waters a given ore deposit belongs has a direct and very important practical bearing upon its exploration and exploitation.

In conclusion, I hold if mining engineers and superintendents understand the work of underground water, understand why and how ore deposits are made, less money will be expended in fruitless exploration; money will not be wasted in searching for deposits at places where nature never placed a deposit. Therefore, it seems to me to be the part of wisdom for a mine owner or manager to make a complete scientific investigation of a deposit of which he has charge in order to ascertain to which of these three classes the deposit belongs; and then to carry out the exploration and exploitation according to the principles which apply to the particular case.

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SECTION E, GEOLOGY AND GEOGRAPHY.

ABSTRACTS of papers read before the Section on August 26–29, 1901, are as follows:

'Some Problems of the Dakota Artesian System': JAMES E. TODD.

This paper presents some of the unsolved problems found in several years' study of the artesian wells of South Dakota. The artesian system shows four or five aquifers, or water-bearing strata, more or less completely separated from one another. Our first problem is, how is this separation accomplished? By sheets of clay wholly, or in part by mutual precipitates between two kinds of water? Again, artesian waters may be divided into soft and hard, and both kinds are found in the same aquifer in different localities. This presents the question, what decides the mineral content of the water at any place? Is it what is brought from its original source, or the composition of the rock in which it is found? The latter seems most accordant with the facts. Again, though from the hydraulic gradient the flow seems to be uniformly towards the southeast, the soft waters in each aquifer are found toward the northwest, and the hard to the southeast. Therefore, another problem is, how can we explain the lime and less soluble salts replacing the soda and more soluble salts in the same stream? Again, a prominent content of the water about Pierre, and extending westward indefinitely, is natural gas, and this gas has been identified with the water itself and not with any carbonaceous stratum above. What then is the origin of the gas? The high temperature with which it is associated, 92° to 102° F., and its intimate mixture with the water, suggest a chemical origin, but nothing in that line, which has been hinted by any chemist, can be conceived to occur in this region. There is no trace of volcanic or crustal disturbance, but from geological relations there is strong ground for believing that extensive carbonaceous deposits may have been formed in the Carboniferous period a little west of Pierre, the eastern edge of which the Dakota formation, which bears the water, directly overlaps. Subterranean heat may distill the gas into the overlying water stratum, carrying the higher temperature from below, and perhaps adding to it by condensation. But, perhaps more strange, a few miles east of Pierre the gas disappears and the temperature of the water declines 20 degrees or more. We have, therefore, another very obscure and difficult problem. What becomes of the gas? This problem in some respects resembles the disappearance of soda ingredients in the water, mentioned above. Perhaps the readiest suggestion is that the gas escapes from the water to the surface, by its greater penetrating power, but no gas springs have been found, and only a little at higher levels, which has been discovered in shallow wells. We have already alluded to the phenomenally high temperature of some wells. This has been well discussed by Darton in the 18th Annual Report U. S. G. S. The oxidation of pyrites he considers inadequate, yet as the higher temperatures are connected with the presence of sodium chloride and gas, so far as we know, it is strongly impressed upon us that some chemical reactions yet undiscovered have something to do with the high temperature, origin of gas, and disappearance of sodium salts in the great eastward-flowing streams of artesian waters.

'Interpretation of Some Drainage Changes in Southeastern Ohio': W. G. TIGHT.

This paper traces some old river valleys and indicates the sequence of events during the changes and the time of the inauguration of the changes.

'Moraines and Maximum Diurnal Temperature': JAMES E. TODD.

It has been noted that the moraines in the James River valley are frequently

wider and rougher on the west side of the valley than on the eastern. This is particularly true of those later than the first, for they are formed on a quite smooth plain. The first is much influenced by preglacial topography. Moreover the western sides of the loops are apt to be at lower altitudes. In seeking for an explanation for this, we find nothing more satisfactory than the fact that the maximum diurnal temperature is uniformly considerably higher after noon, hence the western half of an ice lobe will receive more heat and consequently be more active, *i. e.*, move faster, bring more débris, melt more rapidly, be more apt to detach and bury more ice blocks. The lower altitude may result from the melting back of the ice farther on a concave surface, such as is apt to be left by the former ice sheet. A corollary of this general proposition is that in the northern hemisphere the southern side of an east- or west-flowing glacier will tend to exhibit similar phenomena for a similar reason, viz., because of the southern position of the sun. Instead of curving such glaciers toward the north, as argued several years ago in one of our prominent scientific journals, it will rather tend to quicken the motion in the ice toward the south, though at the same time, because of greater melting, it may not widen the ice, but the contrary. If the débris transported is abundant it may turn the course of the glacier northward, somewhat as the deposition of sediment in a delta or an alluvial fan may divert the stream which forms it. Of course the influence here recognized is not all-powerful, but may be counteracted in certain cases by other conditions.

'On *Campodus*, *Edestus*, *Helicoprion*, *Acanthodes*, and other Permo-Carboniferous Sharks': C. R. EASTMAN.

The genus *Campodus*, known only by fragmentary remains from the Coal Measures, was shown by St. John and Worthen, and later by Max Lohest, to have possessed a typical Cestraciont dentition. The researches of these authors were based upon a unique example of the left ramus of the lower jaw, from which the anterior and posterior extremities were missing. Two specimens are now known, belonging respectively to the Museum of Comparative Zoology at Cambridge and the State University of Nebraska, which exhibit the symphysial series of teeth and incidentally throw new light on the relations of *Edestus*, *Helicoprion* and the like. In one jaw of *Campodus*, presumably the lower, there was one arcuate, median azygous series of symphysial teeth, opposed to which in (presumably) the upper jaw were two corresponding series separated by a slight interval. As successional teeth were developed the functional ones became coiled in a regular arc like *Edestus*, with the coronal buttresses directed inward (posteriorly). The complete whorls of *Helicoprion* are believed to represent a more advanced stage of an entirely homologous dental structure. A new and very large species of *Acanthodes*, represented by a pectoral fin, numerous spines and shagreen, was reported from the Coal Measures of Mazon Creek, Illinois, and reference made to the occurrence of *Phoebodus* in the Keokuk Limestone of Iowa and Permian of Nebraska. The large variety of *Ctenacanthus* spines occurring in the Kinderhook Limestone of Iowa fall into two principal categories, one long and slender and gradually tapering, the other short and blunt. These are probably to be correlated with the first and second dorsal fins of the same individual, instead of being regarded as distinct species.

'Note on Certain Copper Minerals': ALEXANDER N. WINCHELL.

Chalcopyrite has been found more than once as an accidental product in metallurgical operations, but bornite has never been described as formed in the same way, nor as produced artificially by sublimation.

Both these minerals form at the smelter of the Butte and Boston Consolidated Mining Co., at Butte, Montana. They form slowly, attaining their maximum thickness of about four inches in the course of six months to a year. They form in the Allen-O'Harra calciner along the rails in the bed of the furnace. In fact, they not only form beneath the flanges of the rails, but also slowly replace the rails themselves. When the rails are taken out they have only a thin upper surface layer of iron remaining; all the rest has been transformed into chalcopyrite and bornite, with the exception of that portion of the rails completely embedded in the brick bed of the furnace. An examination of these sulphides shows that, while they are somewhat impure from mechanically admixed quartz and perhaps some other foreign matter, they exhibit the true characters and chemical composition of chalcopyrite, coated in places with films of bornite. Both minerals have been formed by sublimation, and not by fusion, since the temperature of the furnace never rises high enough to fuse the ores present. Since these minerals replace and destroy the iron rails of the calciner, their formation leads to the necessity of removing and replacing the rails with new ones once every ten or twelve months.

'Note on the Minerals Associated with Copper in Parts of Arizona and New Mexico': Geo. H. Stone.

In the mountain ranges of southeastern Arizona and southwestern New Mexico are numerous copper-bearing veins in limestones and shaley limestones of Carboniferous age. In respect to the kinds of copper compounds and the occurrence of quartz and hydrous gangue minerals, these veins are not very different from the copper-bearing veins of Colorado and the States northward. Fluorspar is rare, and the sulphates scanty. It is in respect to the kind and quantity of their anhydrous silicates that they are notable. One of the common gangue minerals is pyroxene. Occasionally it occurs as distinct and easily recognizable four-sided needles. Generally it forms small columnar or stellate crystallizations that are scattered through the decomposed and partially replaced lime rock, or it may be enclosed in quartz. Sometimes it forms slabs of asbestos up to two inches in thickness having their fibers parallel and at right angles to the surface of the slab. In a few cases I noticed these slabs having their fibers interlaced in all directions, and then they are very tough and elastic. The pyroxene occurs both in limestones and in porphyry dikes that penetrate the limestones. Asbestos occurs as a gangue mineral at Ward, Boulder County, Colorado, and in some others of the mountain districts, but I have never seen it so abundant as in the Chiricahua range in Cochise County, Arizona. Another common mineral in the veins in question is epidote. It occurs filling small cavities both in limestones and porphyries, and is very common as a product of contact metamorphism. But now and then it occurs in large quantities as gangue material proper. Thus in the California Mining District in the Chiricahua mountains there is a copper-bearing vein which for nearly a mile is composed of a solid mass of epidote wherever it has been opened by cuts and shafts. It is of various widths up to 5 feet. By far the most abundant of the anhydrous silicates in these veins is garnet. It is generally green, but occasionally brownish or yellowish green, and sometimes carmine or rose red. The copper is sometimes found impregnating the garnet mass, but more often occurs in porous quartz alongside of the larger garnet bodies. The garnets occur in irregular masses in the limestone, and often line drusy cavities. They are plainly a replacement of the limestone due to vein metamorphism of the country rock. In parts of the Chiricahua

mountains the copper veins are marked by belts of limestone more or less charged with garnet up to fifty or more feet in breadth.

In the region in question during the upheaval of the mountains, we find that where the strains were relieved by faulting and the uptilting of monoclinal blocks, the limestones retain their fossils and original amorphous condition. But where anticlines were formed there was much lateral (horizontal) pressure, the limestones are re-crystallized to a semi-marble, and the fossils are obliterated. This may be termed regional metamorphism. The same sort of recrystallization has taken place in the lime rock along the copper-bearing veins, and we may term it vein metamorphism.

'The Minerals and Mineral Localities of Texas': FREDERIC W. SIMONDS.

There has been, so far as the author is aware, no attempt to list in a complete form themineral species occurring in Texas. In the 'Mineral Resources of the United States,' for 1882 (Washington, 1883), Professor John C. Smock, of the Geological Survey of New Jersey, who was charged with the preparation of the material illustrative of the 'Eastern Division,' published two tables for the purpose of showing the mineral resources of Texas. The first included 'Ores, Minerals and Mineral Substances of industrial importance and known occurrence, which are at present mined'; and the second, 'Ores, Minerals and Mineral Substances of industrial importance and known occurrence, but which at present are not mined.' Of the former, eight are mentioned; of the latter, 32. In the 'Mineral Resources' for 1887 (Washington, 1888), the same tables, with slight modification, mainly in the matter of additional localities, are repeated. In the First Annual Report of the Geological Survey of Texas (Austin, 1890), Mr. W. von Streeruwitz published a list of minerals, 63 in number, observed in the Trans Pecos region, but the details of occurrence and localities were, unfortunately, not given (pp. 225–226). In the same volume, Dr. Theo. B. Comstock records 111 minerals collected in the 'Central Mineral Region'—the Llano country. This 'includes only those which occur as crystals or in special or rare situations,' and is regarded by him not as complete, but as affording a 'preliminary list of localities' (pp. 379–391). A list of those minerals and rocks of Trans Pecos Texas which, up to this time, could be classified by their appearance, blow-pipe tests and laboratory work, constitutes Chapter IV. of a 'Report on the Geology and Mineral Resources of Trans Pecos Texas,' by W. H. von Streeruwitz (Second Annual Report of the Geological Survey of Texas, pp. 710-713, 1890). It is, as the writer states, "far from being complete, but it comprises a number of the more important and valuable minerals, building stones and ores of west Texas, giving the localities where they were found." Unfortunately, the State does not possess a collection containing all minerals which I have thus far been able to list; and, as a consequence, the information concerning this occurrence has been derived from many sources, viz.: from a careful examination of the various reports relating to the geology of the State and its resources, keeping in mind at all times the value, as far as it could be estimated, of the observer as an authority. On the same basis, the various scientific journals have been gone over, and the 'transactions' of the different learned societies. Thus far, I have recorded as occurring in Texas one hundred and fifty minerals, varieties, and mineral substances, exclusive of rocks, of which eight are at present of economic importance, viz.: petroleum, coal, lignite, limonite, salt, gold and silver. Of localities the number has, even within the last few months, been enormously increased.

'Note on the Extinct Glaciers of New Mexico and Arizona': Geo. H. Stone.

In southwestern Colorado there were once extensive glaciers on the La Plata and San Juan mountains. The largest of these was 70 miles long and filled the valley of the Las Animas river. It deposited a terminal moraine just north of Durango, Colo., but appears not to have reached so far south as the 37th parallel of latitude. In New Mexico east of the Rio Grande the only extinct glaciers that I have been able to trace were along the high range that forms the southern extension of the Sangre de Christo range of Colorado. Each lateral valley of this range contained its glacier both in Colorado and as far south in New Mexico as a point not far north of Santa Fe. In the region south of the Galisteo are the Ortiz, San Pedro, San Dias, Pedernal, Gallina and Jicarilla mountains. I have visited all these mountains and found no proof of the former existence of glaciers. South of White Oaks is a lofty north and south range—the Sierra Blanca. It is the highest range in that part of New Mexico, probably rising to near 11,000. It is a place of great snowfall, as its name signifies. In valleys of northern exposure I found large masses of snow late in June. I was not able to find moraines. West of the Rio Grande the main southeast spur of the San Juan mountains passes into New Mexico as the Conejos range. This range falls rapidly toward the south and was glaciated for not more than 30 to 50 miles south of the Colorado-New Mexico line. South of this there are no mountains in western New Mexico so high that we could expect to find traces of glaciers on them until we reach the lofty Mogollons. They have a heavy snowfall. They are rather inaccessible and I have not visited them. I have explored the higher mountain ranges that lie south of the Gila river in New Mexico and Arizona, but no moraine or other sign of a glacier was I able to find. The farthest south and west I have found traces of extinct glaciers is at Prescott, Arizona. Around Prescott are numerous moraines. The highest part of the névé of this glacier could not have been much above 9,000 feet. The central part of the glacier is approximately in N. Lat. 34° 30′. The occurrence of an ancient glacier so far south as this was probably due to a very great snowfall owing to the proximity of the ocean. It is doubtful if there was any mountain range high enough to have had its glaciers in glacial time between Prescott and the Sierra Nevada. Probably there were then small glaciers in some of the cirques of northern exposure among the mountains directly southeast of Prescott. We may yet find that the glaciers reached their southern limit in the Mogollon mountains of New Mexico and Arizona.

'The Pre-glacial Surface Deposits of Lower Michigan': A. C. Lane.

Some years ago in working out the general system of drainage of the basin of the Great Lakes, before it was disarranged by the ice from the north, Professor J. W. Spencer drew a sketch map indicating the great streams flowing down to Lake Michigan and Saginaw Bay and joining the Laurentian River, which flows off across Canada. In this scheme of drainage he has been followed by most of the writers since, and his work has been somewhat elaborated by Mr. E. H. Mudge in an article in the *American Journal of Science*, Volume 4, 1897, page 383. There were, however, certain arguments against the idea that the center of lower Michigan drained through the Saginaw Bay. Directly in the mouth of the bay is a group of islands, the Charity Islands, which are composed of cherty, sub-Carboniferous limestone, of about the age of the Upper St. Louis. On both sides of the bay occur outcrops of the same limestone. The mouth of the bay is shallow,

and the ledges of limestone can almost be traced continuously across it not far below the lake surface, and as the elevation of the bed rock surface around in Bay County is, as Spencer and others have remarked, considerably below the present lake surface, it seems hard to assume that any river used to flow northeast out of the Bay. The results of my studies of the rock surface topography of Huron County, published in Volume 7 of our reports, based on the extensive lists of borings catalogued there, showed clearly a river system flowing southeast, gathering strength. Again when I came to discuss the general subject in Water Supply Paper No. 30, it became evident that the Saginaw lobe of ice did not advance as far, proportionately, as Michigan or the Huron-Erie, being retarded, apparently, by this limestone ridge. And, moreover, the result of borings for coal, oil, gas and salt throughout the Saginaw valley made it pretty clear that, before the ice age this valley did not drain as at present, but to the west and northwest. The evidence which I presented on this point, in Water Supply Paper No. 30, was very candidly accepted by Mr. Mudge, who at the same time pointed out some emendations in detail. Since, however, authors are still following Spencer, it may not be inappropriate to call attention to the subject once more and to present some of the elevations above tide which make it reasonably certain that the drainage of lower Michigan was to the northwest. The coal basin of Michigan is surrounded by a series of ramparts of which the sub-Carboniferous limestone, Marshall sandstone, Devonian limestone and Niagara limestone are the most important. It is probable that in the neighborhood of Saginaw Bay all these ramparts were broken down by pre-glacial rivers, except the innermost, curved to the right and left, so that finally when the ice overrode this the lobe extended in the general direction of the ice motion, that of Saginaw Bay. The shore of Saginaw Bay has now been so completely lined with borings that it is not conceivable that any valley of the first order 300 feet below lake level can go out that way, while it is only a few miles south, in Saginaw County and west of it, that we find bed rock elevations of only 300 and 400 feet below tide. The west part of the State is so heavily covered with drift that our information regarding the bed rock surface is much more scanty, but we know that in the northwest part, bed rock surface is below sea level. The great group of lakes resembling somewhat the Finger Lakes of New York, and the bays which are associated, Great and Little Traverse Bays, require special explanation, and seem to find it in some large pre-glacial valley that had irregular pre-glacial topography, such as would be found where the escarpments of the middle and lower Devonian limestone come close to master valleys. It seems to me possible that before the last ice age the main streams connecting the valley of Lake Michigan with that of Lake Huron may have passed from just north of Petoskey to somewhere near Cheboygan; at any rate, there was a considerable stream there. So far as the present indications of levels are concerned, it would seem as though the *streams were flowing to the south rather than to the north*, but before we can settle this question, we must hear from the geologists of other States.

The following papers were also read before the American Geological Society and the Section.

1. 'Account of the Colorado Excursion': C. R. VAN HISE.

2. 'Junction of the Lake Superior Sandstone and the Keweenawan Traps in Wisconsin': U. S. GRANT.

3. 'Hydrographic History of South Dakota': J. E. TODD.

4. 'The Still Rivers of Western Connecticut': W. H. Hobbs.

5. 'Geology of the Northeast Coast of Brazil': John C. Branner.

6. 'Classification of the Geological Formations of Tennessee': James M. Safford.

7. 'Horizons of Phosphate Rock in Tennessee': James M. Safford.

8. 'The Oscillations of the Coast Ranges of California': A. C. Lawson.

9. 'Some Features of the Geology of Golden, Colorado' (a paper preparatory to the excursions in Morrison and Golden on Tuesday and Wednesday): H. B. Patton.

10. 'The Geological Occurrence of Oil in Colorado': A. Lakes.

11. 'Report on Some Studies Relative to Primal Questions in Geology': T. C. Chamberlin.

12. 'A Plea for Greater Simplicity in the Language of Science': T. A. Rickard.

13. 'Sandstone Intrusions near Santa Cruz, California' (lantern illustrations): J. F. Newsome and J. C. Branner.

14. 'On the Pleistocene Deposits of Iowa' (lantern illustrations): Samuel Calvin.

15. 'Problems of the Quaternary Deposits of the South Platte Valley': George L. Cannon.

16. 'Physiography of the Boston Mountains, Arkansas': A. H. Perdue.

17. 'A Quantitative Study of Variation in the Fossil Brachiopod *Platystrophia biforta*, Schl.': E. R. Cumings and A. V. Mauck.

MEMBERSHIP OF THE AMERICAN ASSOCIATION.

The following have completed their membership in the American Association for the Advancement of Science during the month of October:

Hendery Allison, M.D., 149 Richmond Terrace, Port Richmond, N. Y.

Jacob H. Arnold, Teacher of Natural Science, Redfield College, Redfield, South Dakota.

Samuel M. Bain, Professor of Botany, Univ. of Tenn., Knoxville, Tenn.

Dr. Philip P. Calvert, Professor of Zoology, Biological Hall, Univ. of Pa., Philadelphia, Pa.

John J. Davis, Attorney-at-law, Clarksburg, W. Va.

Miss Anna M. Deens, Botany and Zoology, 216 North Ave., W., Allegheny, Pa.

Miss Abigail C. Dimon, Zoology, Radnor Hall, Bryn Mawr, Pa.

Manuel V. Domenech, Civil Engineer and Architect, Lock Box 151, Ponce, Porto Rico.

Fred. N. Duncan, Chemist, Georgetown, Texas.

Gano S. Dunn, Electrical Engineer, Crocker-Wheeler Co., Ampere, N. J.

Edward M. Ehrhorn, County Entomologist, Santa Clara Co., Mountain View, Cal.

Sumner B. Ely, Mechanical Engineer, Vandergrift Building, Pittsburg, Pa.

Robert Gauss, Editor *Denver Republican*, Denver, Colo.

Professor Chas. B. Gilbert, Educator, 106 Brunswick St., Rochester, N. Y.

Charles P. Greenough, Attorney-at-law, 39 Court St., Boston, Mass.

Mrs. Margaret L. Griffin, Botany and Geology, Keene, N. H.

Wm. C. A. Hammel, Department of Physics, State Normal School, Baltimore, Md.

Judge Lynde Harrison, Lawyer, 52 Hillhouse Ave., New Haven, Conn.

Edwin Hebden, Principal, Group A, Public Schools, 730 Colorado Ave., Baltimore, Md.

Ray V. Hennen, Civil Engineer, care of Carter Oil Co., Sistersville, Tyler Co., W. Va.

Sidney Hosmer, Electrical Engineer, 3 Head Place, Boston, Mass.

Edward H. Kraus, Instructor Mineralogy, Syracuse Univ., 615 Butternut St., Syracuse, N. Y.

Lucinus S. McCoy, Whitten, Hardin Co , Iowa.

George D. Markham, 4961 Berlin Ave., St. Louis Mo.

Hu Maxwell, Treasurer Transallegheny Historical Society, Morgantown, W. Va.

Miss Florence Parker, Geology, 10,340 Longwood Ave., Chicago, Ill.

John Patton, Counsellor-at-law, 925 Mich. Trust Co. Bldg., Grand Rapids, Mich.

Samuel K. Reifsnyder, Instructor Science, High School, 73 Embury Ave., Ocean Grove, N. J.

Dudley S. Reynolds, M.D., Louisville, Ky.

James F. Rhodes, Author and Historian, 392 Beacon St., Boston, Mass.

Maurice Ricker, Zoology, High School, Burlington, Iowa.

Milnor Roberts, Professor Mining and Metallurgy, Univ. of Washington, Seattle, Wash.

Sanford Robinson, Civil and Mining Engineer, Steeple Rock, Grant Co., New Mexico.

David J. Satterfield, D.D., President, Scotia Seminary, Concord, North Carolina.

Miss Clara B. Sayre, South Bethlehem, Pa.

Wm. J. Sutton, Geologist, Esquimalt & Nanaimo Ry. Co., Victoria, B. C.

E. S. G. Titus, Entomologist, Nat. Hist. Bldg., Urbana, Ill.

David M. Totman, M.D., Physician and Surgeon, 303 Montgomery St., Syracuse, N. Y.

Andrew J. Townson, President, Board of Education, Granite Building, Rochester, N. Y.

Dr. Frederick C. Waite, Assistant Professor of Histology and Entomology, Medical Dept., Western Reserve Univ., Cleveland, Ohio.

Charles R. Walker, M.D., Concord, New Hampshire.

Joseph R. Watson, Professor of Natural Science, Berea College, Berea, Ky.

Wm. G. Wilkins, Professor of Mining Engineering, Western Univ. of Pa., Westinghouse Bldg., Pittsburg, Pa.

THE AMERICAN MICROSCOPICAL SOCIETY.

THE twenty-fourth annual meeting of the Society was held in Denver, August 29 to 31. As anticipated, the attendance was not large, yet the strong series of papers presented and the completion of the Spencer-Tolles Fund make the occasion a noteworthy one. At the business session on Thursday there were read reports of the secretary, treasurer and custodian on the condition of the Society, and the usual committees were appointed. Some minor changes in the by-laws of the Society were recommended and subsequently adopted. The report of the Committee on the Spencer-Tolles Fund showed that it had finally been brought to the limit of $1,200, set at the New York meeting, and recommended that a specific sum be set aside yearly from the income for the encouragement of such definite research of a microscopical character as shall be approved. The committee reported $50 available for use in the current year, and the final apportionment of the amount was left to the Executive Committee.

The meeting on Thursday evening was in charge of the Colorado Microscopical Society. After an address of welcome by the president of that organization, Dr. A. M. Holmes, and a response by the retiring president of the American Microscopical Society, Dr. A. M. Bleile, the annual address was read by the incoming president, Dr. C. H. Eigenmann, on 'The Solution of the Eel Question.' The paper was illustrated by both charts and lantern slides and proved of great interest. At the close a most pleasant informal reception was tendered the visiting society and guests by the Colorado organization, to whom most cordial thanks are due for many hospitalities.

The following papers were among those presented at the general sessions of the Society:

'The Early Morphogenesis and Histogenesis of the Liver in the Pig': D. C. HILTON, Chicago, Ill.

'The Histology of the Stigmata and Stomata in the Peritoneum': A. E. HERTZLER, Halstead, Kas.

'A Rearrangement of the Families and Genera of the Conjugatæ': C. E. BESSEY, Lincoln, Neb.

'A New Species of *Crinothrix* (*C. manganifera*)': D. D. JACKSON, New York City.

'The Amount of Dissolved Oxygen and Carbonic Acid in Natural Waters and the Effect of these Gases on the Occurrence of the Microorganism': G. C. WHIPPLE and H. N. PARKER, New York City.

'Notes on Colorado Protozoa, with Description of New Species': A. E. BEARDSLEY, Greeley, Col.

'Notes on Colorado Entomostraca': A. E. BEARDSLEY, Greeley, Col.

'A Review of the American Species of *Cochleophorus* and *Curvipes*': R. H. WOLCOTT, Lincoln, Nebr.

'An Apparently New *Hydra* from Montana': M. J. ELROD, Missoula, Mont.

'Some Histological Features of *Echinorhynchi*' (Illustrated): H. W. GRAYBILL, Lincoln, Neb.

'The Debt of American Microscopy to Spencer and Tolles': W. C. KRAUSS, Buffalo, N. Y.

'Mounting Soft Tissues for Microscopical Examination': M. A. D. JONES, New York City.

'Modification of Some Standard Laboratory Apparatus': S. H. GAGE, Ithaca, N. Y.

'Laboratory Photographic Apparatus': S H. GAGE, Ithaca, N. Y.

'The Plankton of Lake Maxinkuckee, Ind.': CHAUNCEY JUDAY.

The following officers were elected for the year 1901–02:

President, Dr. Charles E. Bessey, University of Nebraska, Lincoln, Nebr.

First Vice-President, Dr. E. A. Birge, University of Wisconsin, Madison, Wis.

Second Vice-President, Mr. John Aspinwall, New York City.

Elective Members of the Executive Committee, Dr. A. M. Holmes, Denver, Col.; Dr. V. A. Latham, Chicago, Ill.; Mr. G. C. Whipple, New York.

Secretary, Dr. Henry B. Ward, University of Nebraska, Lincoln, Nebr.

Treasurer, Mr. J. C. Smith, New Orleans, Louisiana.

Custodian, Mr. Magnus Pflaum, Pittsburg, Pa.

Resolutions of regret at the death of ex-President E. W. Claypole, the sad news of which came to the Society as it was in session, were read and ordered spread upon the minutes of the Society.

HENRY B. WARD,
Secretary.

TOTAL ECLIPSE OF THE SUN.*

AMONG the unsolved problems for the twentieth century are many relating to the central luminary of our system. Many points of scientific interest to students of solar phenomena are still to be discovered, and it is true that when we come to consider what we do not know about the sun, we are rather startled to find our knowledge about the heavenly body which has most interest to us human beings so incomplete. The distance is not known to the accuracy which we wish it, and very little is known of the laws of motion at the surface of the sun or the manner in which light and heat are sent out. The spectroscope tells us what metals are present at the surface of the sun, but, as yet, it has not decided the question of the extent of the different gases, nor the position of the 'reversing layer.' In fact, the very existence of the 'reversing layer' has been disputed. The most beautiful of all natural phenomena, the corona, is to us an unsolved mystery. Much time has been spent delineating its form, and in late years some connection has been established between the form of the corona and the sun-spot period; but what is the meaning of this connection? and in turn, what is the relation between sun spots and terrestrial magnetism? The spectroscope tells us that 'coronium' forms a constituent of the corona, but what is 'coronium'?

These and many other points are still to be solved by astronomers and physicists. Their solution depends almost entirely on the observations, on the average, of only a few minutes each year, for it is only when the sun is eclipsed that most of these problems can be investigated.

The United States government recognized the importance of these inquiries, and through Congress appropriated money to equip and send out an expedition to observe the eclipse of the sun visible in the island of Sumatra in the East Indies, on May 18, 1901.

This expedition consisted of thirteen, a number which would have caused terror to enter the hearts of people less sensible than astronomers. This is the largest party, we believe, ever sent out by any government for such a purpose.

The thirteen were made up of two separate parties, two members, Professor C. G. Abbot and his assistant, Mr. Draper, representing the Smithsonian Institution, and eleven the Naval Observatory. Six belonged to the staff of the observatory, and consisted of Professor A. N. Skinner, U. S. N.; Professor W. S. Eichelberger, U. S. N.; Professor F. B. Littell, U. S. N.; Mr. L. E. Jewell, Mr. W. W. Dinwiddie and Mr. G. H. Peters. The remainder of the party was made up of Professor E. E. Barnard, Yerkes Observatory; Dr. W. J. Humphreys and Mr. H. D. Curtis, of the University of Virginia; Dr. N. E. Gilbert, of Hobart College, and the writer.

* Read before the New York Academy of Sciences, November 4, 1901.

The members crossed the continent by various routes, meeting together for the first time in San Francisco. Transportation was furnished by government steamers, and on February 16, on board the army transport *Sheridan*, the expedition started to demonstrate that the earth is round by sailing west in order to reach the East Indies. The Army was to care for the party as far as Manila, and from there to Sumatra the Navy Department was to attend to us. Life on board the transport was very pleasant, many entertainments being provided by the officers, soldiers—and astronomers, too—to while away the hours.

Honolulu was reached the morning of February 25. A three days' stay there enabled the party to see most of the sights of the island of Oahu, making a most pleasant break in our voyage of thirty days to Manila. The Social Science Club of the Hawaiian Islands was exceedingly kind to the astronomers. Among the courtesies shown was a drive up the historic Pali, a huge precipice with a sheer drop of 500 feet, over which one of the old kings is said to have driven his enemies to their death. In the evening a meeting of the club was held at which Professor Barnard gave one of his interesting illustrated talks. The three days' stay was exceedingly interesting, giving an excellent opportunity of seeing how the United States was progressing in the government of his new outside dependencies.

The 180th meridian was crossed at 11:40 on the night of March 4, and as a result our day of March 5 was of only twenty minutes' duration. On crossing the line, Father Neptune and his court paid the ship a visit, the celebration of which was greatly enjoyed by soldiers, sailors and passengers.

Manila was reached on March 18, and a stop of eight days was made while arrangements were made with the Navy Department to carry us the remaining 2,200 miles to Sumatra. The Manila observatory, which was visited several times, is doing an exceedingly important work, the value of which is recognized by the United States authorities. The predictions for typhoons come from the observatory, and in view of the enormous shipping of the port, this service is invaluable. A time service and weather bureau with 76 stations are about to be instituted by the observatory authorities. Of course, the most interesting sights to Americans were the Spanish wrecks at Cavite, monuments to the valor of Admiral Dewey.

The U. S. S. *General Alava*, a former Spanish ship, was put at the disposal of the expedition, and on March 26 we set sail for Sumatra. Pleasant weather was experienced through the China and Java Seas. The equator was crossed on March 31, and 'Neptunus Rex' was celebrated in true man-of-war style.

On April 2, the ship passed within half a mile of Krakatau, excellent opportunity thus being given to see this historic volcano. Where, before the eruption of 1883, had been a hill of perhaps 1,000 feet, bottom is now not reached at the depth of 164 fathoms.

On April 4, the *General Alava* steamed into the beautiful harbor of Emma Haven, the port of Padang, the capital of the island of Sumatra, and a first glimpse was obtained of the Malay, with whom the next two months were to make us so well acquainted. We were the first astronomical expedition to arrive, ours being, in fact, the first American ship which ever entered port there. But in a few days Professor Perrine and the astronomers from the Massachusetts Institute of Technology arrived, to be soon followed by parties from England, Holland, France, Russia, Japan and India.

It took some time to get accustomed to the East Indian ways, particularly the cus-

toms of eating and bathing, and many amusing incidents were the result. In the East Indian hotels the bath rooms are away out in the yard, a hundred yards or more from your bedroom. There is no bath-tub like ours—in fact, plumbing of any sort is unknown there—and the bath is taken by dipping water from a cistern by means of a bucket and throwing it over yourself—and a very good bath it gives, too. One of our English friends mistook the cistern for his tub, and got in, greatly to the consternation of the Malays.

The Dutch did everything in their power to make our stay in the island pleasant, with the result that everything was accomplished with remarkably little trouble and difficulty. Free passes were furnished to all astronomers, all freight was transported without charge, and laborers, consisting mainly of convict coolies, were furnished in as large numbers as were wished. In fact, too much cannot be said in praise of the courtesy and kindness of the Hollanders to all the foreign astronomers. The scientists became known so quickly to the Dutch and Malays, that 'Zoneclips' soon became the talisman that made all things work together for our good.

Before reaching Sumatra it had been decided to divide the expedition into two parts, the main portion going to Solok, near the central line of totality, and a smaller number to Fort de Koch, near the northern limit of the path; both stations being on the line of the 'Staatsspoorweg op Sumatra,' the government railroad running about 100 miles inland. After two weeks' stay in the island, and in view of the fact that so much cloudy weather was experienced each day at the time of totality, it was decided best to still further divide the expedition. Consequently, another station was established at Sawah Loento, the terminus of the government railroad, twenty miles beyond Solok.

The American governmental party was thus divided into three. Everybody was hard at work by the middle of April, but as we had to depend on Malay bricklayers and carpenters, work did not progress as rapidly as was desired. These *orang tukang* are frightfully slow, always squatting down to work, and using tools of the most primitive sort. It was a sore trial, indeed, seeing everything proceed at such a snail's pace, but by dint of hard labor, and much talking of Malay on our part, with several English expletives thrown in, everything was all up and adjusted in good time.

At Solok, where the main part of the expedition was located, an almost ideal spot was found for an eclipse camp. This was an old fort recently evacuated by the Dutch, the buildings serving as most excellent sheds for storing the instruments. Professor Barnard had with him the 61½-foot lens with which he obtained such good results at the 1900 eclipse at Wadesboro. This was used in connection with a cœlostat, the telescope tube being horizontal, and ending in a dark room where the plates, in holders, were to be placed on a sliding carrier at eclipse time. One plate used by him, measuring 40 x 40 inches, was to be exposed at the middle of totality for two minutes and a half. The other plates were 30 x 30 and 11 x 14, but notwithstanding their great weight, so carefully was the construction looked after that the plates were changed remarkably quickly. True, totality lasted 5 min. 51 sec. at Solok, but the seconds are valuable, even with such a great duration.

Professor Abbot was prosecuting his researches along two lines. With a highly sensitive bolometer, which has been brought to such a high degree of excellency at the Smithsonian Institution, he was investigating the heat of the moon and the corona; and with four photographic lenses of 11 feet focus, searching for intra-Mercurial plan-

ets. A region about $20° \times 24°$ was covered in the vicinity of the sun, and the exposures were duplicated in order to check all suspected objects.

The spectroscopic work was under the general direction of Mr. Jewell. He himself used a 21-foot concave grating, used without slit as an objective grating. Mr. Dinwiddie employed a 6-inch prismatic camera, and Professor Littell a flat grating with slit, in order, if possible, to detect the rotation of the corona. Professor R. W. Wood's apparatus was used by Dr. Gilbert, and several small cameras by Mr. Curtis.

At Fort de Koch were two instruments, the 40-foot photoheliograph and the spectroscope in charge of Mr. Peters and Dr. Humphreys, respectively. The latter was a direct concave grating used without slit, and had a ruled surface of 8×5 inches. It was one of the last gratings ruled by Schneider under the direction of Professor Rowland, and was the largest grating ever made. Unfortunately, the diamond broke down in the middle of the ruling, and it was found necessary in Sumatra to cover up half of the grating; but notwithstanding this fact, spectra of remarkable brilliancy and definition were obtained.

At Sawah Loento were placed two instruments under the direction of the writer. The spectroscope was a 6-inch flat grating of 15,000 lines, used without a slit in connection with a quartz lens of 72-inch focus. The camera had a focal length of 104 inches and an aperture of 6 inches, which, however, was stopped down to $4\frac{1}{2}$ inches.

This was the instrumental outfit of the governmental parties.

At Sawah Loento were also situated the Massachusetts Institute party, and Mr. and Mrs. Newall, of Cambridge, England, the work of the former embracing a general photographic program, together with investigations of the magnetic disturbance during the eclipse. Our English cousins had some very important spectroscopic problems to carry out.

The three stations situated within fifty miles of the equator had difficulties to contend with that could not be shouldered on to the backs of the Malays. The hot tropical country requires a great amount of rain, and from our experience it seems to get all it needs. At Padang, according to the meteorological reports, there is an annual rainfall of 187 inches, an average of half an inch each day. In fact there is seldom a day without rainfall. Up to the first of May, the sun had hardly been seen by us in Sumatra. The result was that great difficulty was experienced in getting enough clear weather to adjust the instruments, the nights being as cloudy as the days. Professor Barnard carried with him some portrait lenses in order to continue his photographic work on the Milky Way, and carry his investigations into the southern heavens. Those who know Professor Barnard will acknowledge that he tried hard enough to make the exposures, but he failed, owing to continued cloudy weather, to get a single fully exposed plate.

As the time approached closer and closer to the day of the eclipse, great concern was felt as to the probability of a clear sky for the all-important six minutes shortly after noon, on the day of May 18, 1901.

At Sawah Loento it dawned clearer than it had been for a week, but about eight o'clock it clouded up and dashed the hopes of everybody to the ground. About ten it cleared beautifully, and our hopes soared again. First contact was observed with a perfectly clear sky, but soon clouds began to gather, and half an hour before totality the sky was completely overcast.

A direct-vision spectroscope was employed to watch the 'flash,' but so cloudy was it that the first 'flash' passed unnoticed and the total phase had begun before we were hardly aware of it. It remained

cloudy throughout the eclipse, but was a trifle clearer than at the beginning of totality, so that the 'coronium' line was very well seen. The second 'flash' appeared stronger than we would have thought possible through the clouds. The reappearance of the sun was welcomed by a shout from the Malays assembled in the valley.

On the spectrographs taken during totality nothing of the coronal spectrum was visible. The hydrogen lines H and K appeared, but these were due to the upper chromosphere. Although an exposure was made about the time of the first flash, nothing was found of this on the photographic plate. The second flash, however, showed more than was expected, and gave results fairly well developed. The photographs of the corona showed an extent of about a diameter, but with very few details of streamers.

At Solok the weather was even worse than at Sawah Loento; so dense were the clouds, in fact, that the position of the sun could hardly be seen. Mercury and Venus, which were visible at Sawah Loento throughout totality, were seen only for a few seconds at Solok. So cloudy was it that Professor Abbot did not even attempt anything with his bolometer. With the exception of this, all other programs were carried out as if it had been clear. The results, however, were almost *nil*. Where Professor Barnard had hoped for marvelous results of detail on his large 40 x 40 plate, hardly a trace of even a prominence was seen.

One hour after the eclipse was all over, the clouds cleared away, and a beautiful blue sky remained for the rest of the day. Alas! that the eclipse did not occur at one o'clock instead of at twelve.

A few hours after the work was over at Solok, word came to the despondent people there, that at Fort de Koch the weather had been perfect and that the program had been carried out without a hitch. This was good news indeed. Several excellent spectrographs were obtained with the concave grating; the photographs taken with the 40-ft. showed splendid detail in the polar and equatorial streamers. Thus it happened that one party of the American expedition met with perfect success, one with partial success, but the third with no results at all to show for the hard work and time spent.

The other observers in Sumatra fared about as well as did the Naval Observatory party, the clouds being general over the region covered by the scientists. Nowhere else were they as dense as at Solok, but at no place where an astronomical expedition was located were perfect weather conditions experienced except at Fort de Koch.

To meet such a perplexing state of affairs is rather disappointing after traveling half way around the world in search of scientific knowledge, but it is to be expected when the object of investigation is the sun. The conditions were not so bad as at the eclipse of 1896, when no sun at all was seen, but, coming so soon after the 1900 eclipse which was so generally observed in this country, and with such perfectly blue and tranquil skies, the contrast was anything but pleasant.

At Sawah Loento, totality lasted 5 min. 41 sec. The chromosphere and prominences at mid-totality would, it would have been thought, have been so thoroughly covered up that the atmosphere would not have been lit up to any great extent, and consequently it would be very dark during totality. This was expected, and to prepare for it lanterns were got ready to aid the time-keepers and observers to see. But the expected did not happen, and at no time during totality was it too dark to see the hands of an ordinary watch. In fact, it was hardly any darker than at the eclipse of last year, which the writer saw from

Griffin, Ga., situated near the northern edge of the path of totality and experiencing a duration of only 38 sec. The reason for the brightness of the air was evidently the sun shining on the clouds, which in turn illuminated the atmosphere. The clouds were cirro-cumulus, and, no doubt, very high.

It is almost too early to tell just how much our knowledge of the sun has been increased, but it is certain that much of scientific value will be added to science as a result of the observations of the eclipse of May 18, 1901.

To astronomers the voyage itself was interesting in showing the stars of the southern hemisphere, and in losing sight for a couple of months, of Polaris, the star that appeals to all of us as a personal friend.

Perhaps, outside the eclipse, the most striking feature of the expedition astronomically was the independent discovery on May 3 of the great comet, the honor belonging to Mr. Dinwiddie of the Naval Observatory. It was indeed a magnificent sight, appearing shortly after sunset, with a sweeping tail visible to the naked eye for more than eight degrees in length. We watched eagerly during every clear night—but unfortunately there were not very many beautiful nights—and it was photographed by Professor Barnard. But, if the great comet was seen, the sudden outburst of the star in Perseus escaped our attention. After leaving San Francisco, heavy weather and cloudy nights were experienced till after leaving Honolulu, February 28. As there is as yet no cable to the Hawaiian Islands—but this, we hope, is to come in the near future—no tidings were received of the new star until after the arrival of the party in Sumatra, when Perseus was no longer visible.

The expedition arrived in San Francisco July 16.

The next eclipse that will be generally observed is that of August 30, 1905, which will be visible in Labrador, Spain, and northern Africa. The points of investigation will be along the same lines as carried out by the American parties, but it is to be hoped that better weather conditions will be experienced than in the Sumatra eclipse of May 18, 1901.

S. A. Mitchell.
Columbia University.

SCIENTIFIC BOOKS.

Alaska: Volume I., Narrative, Glaciers, Natives, by John Burroughs, John Muir and George Bird Grinnell; Volume II., History, Geography, Resources, by William H. Dall, Charles Keeler, Henry Gannett, William H. Brewer, C. Hart Merriam, George Bird Grinnell and M. L. Washburn. New York, Doubleday, Page and Company. 1901. [Superimprinted] Harriman Alaska Expedition, with the cooperation of the Washington Academy of Sciences. [Edited by Dr. C. Hart Merriam.] With 39 colored plates, 85 photogravure plates, 5 maps and 240 text figures. Pp. xxxvii + 383. Price, $15.

The Harriman Expedition of 1899 was one of the scientific events of that year; and the issue of this sumptuous summary of results is one of the literary events of the current year. Conceived as a pleasure trip, matured in mind as a summer school for a family and a few friends, the Harriman outing took final form as an expedition for research in a region of paramount present interest to science, industry, commerce and public policy. The sea trip—the essential part of the expedition—was made in the steamer *George W. Elder*, with an aggregate personnel (including officers and crew) of 126. The 'scientific party' numbered 25, and there were three artists, two photographers, two stenographers, a surgeon, an assistant surgeon and a trained nurse, besides eleven hunters, packers and camp hands. Nor was the 'scientific' corps such in name only; none were smatterers, and all ranged from distinction through eminence to preeminence in their respective lines, which included anatomy, botany,

engineering, ethnology, forestry, geography, geology, mineralogy, ornithology, paleontology and zoology. Along all these lines the researches were energetic and successful; and the more general results are incorporated in the two volumes just issued, and in a series of special memoirs now in the course of publication by the Washington Academy of Sciences, but designed for ultimate reissue in volumes supplementary to those under notice. These volumes themselves, produced as they were by leading authorities, must form a standard source of knowledge concerning Alaska; and when the series is completed it will undoubtedly command a high place among the classics of place and country.

The body of the first volume opens with a narrative of the expedition by John Burroughs; then follow chapters on the 'Pacific Coast Glaciers,' by John Muir, and on the 'Natives of the Alaska Coast Region,' by George Bird Grinnell. The second volume comprises 'The Discovery and Exploration of Alaska,' by William Healey Dall; 'Days Among Alaska Birds,' by Charles Keeler; 'Forests of Alaska,' by Bernard E. Fernow; 'General Geography,' by Henry Gannett; 'The Alaska Atmosphere,' by William H. Brewer; 'Bogoslof, Our Newest Volcano,' by C. Hart Merriam; 'The Salmon Industry,' by George Bird Grinnell; and 'Fox Farming in Alaska,' by M. L. Washburn. There is also a preface by Mr. Harriman and an introduction by Dr. Merriam, together with an opening poem by Charles Keeler; while the work ends (save for the excellent Index) with an effective poem by Dall, captioned 'The Song of the Innuit' and (somewhat tautologically) listed as 'The Innuit People.' It would be impracticable to abstract the papers prepared by the several contributors; it must suffice to note that they are, without exception, excellent, authoritative, well written, and carefully edited by a participant in the expedition, himself a recognized authority in scientific matters. Merely as examples, it may be noted that the chapter on glaciers came from the pen of the world's most sympathetic student of ice fields and ice streams; that the historical chapter was written by the leading authority on Alaskan exploration; and that the account of Alaskan geography and the accompanying maps were prepared by our foremost practical geographer. The maps, although small, show the general features of the territory satisfactorily; they are, of course, quite up to date, embracing the results of all surveys up to 1900, including those of the expedition itself, as well as those of the U. S. Geological Survey and the U. S. Coast and Geodetic Survey.

The volumes are especially notable for the beauty and fidelity of the illustrations, most of which were based on photographs. The lithograph plates have never been excelled in delicacy and refinement of both color and form; many of them are pictorial gems, displaying landscape and waterscape, mountain and valley, flower and foliage, fur and feather, with a faithfulness seldom sought and never passed. The photogravures are of corresponding excellence; while the text figures combine artistic quality and graphic fidelity in remarkable degree. The typography, paper and binding are correspondingly sumptuous; so that the book is a thing of beauty as well as an object of utility.

Perhaps the most serious defect of the work (despite evident editorial care, which might well have been more prominently acknowledged) is the discontinuity naturally growing out of the multiple authorship; another defect, which must somewhat discommode librarians and dealers as well as students, is the absence of a definite title. 'Alaska,' indeed, stands out boldly on the title-page in carmine ink, while the publisher's imprint and the expeditionary superimprint and vignette are uniform, but otherwise the title-pages are diverse—and worst of all, the title on the back is not that of the book but that of the expedition.

W J M.

The Protozoa. By Gary N. Calkins, Ph.D. Columbia University Biological Series, Vol. VI. New York, Macmillan Co. Price, $3.

It is no easy task to compress into a volume of scarcely more than 300 pages a résumé of even the more important facts and theories relating to a large group of organisms like the Protozoa. The difficulty of the task is apparent when one stops to consider that the very position of the Protozoa in the animal kingdom has of necessity enveloped them in a nimbus of

biological speculation. They have been and will long continue to be the one group about which cluster the numerous theories of biogenesis, the origin of the Metazoa, the origin and significance of sex, heredity and death, the dawn of consciousness and instinct and innumerable problems of lesser magnitude. Dr. Calkins is to be congratulated on having worthily overcome, or at any rate adroitly avoided, many of the difficulties of this task. At the same time he has upheld the high standard of scholarship set by the previous volumes in the well-known 'Biological Series.'

As Dr. Calkins informs us in his preface, "The subject-matter of the volume is treated from three points of view: (1) The historical, to which the first chapter is devoted. (2) The comparative to which five chapters are given, one to the group of Protozoa as a whole, the other four to the main classes. (3) The general, to which three chapters are devoted. One of these is given to the phenomena of old age or senile degeneration in Protozoa and renewal of youth through the union of two individuals, and to the bearing of these phenomena upon sexual reproduction in general. Another is given to the special structures of nuclei and centrosomes of the Protozoa; this, the most technical chapter in the book, is introduced because of the growing importance which the Protozoa have in the problems of cellular biology, especially with those dealing with the origin of the division-center and its accompanying structures in the cells of the Metazoa. The last chapter is devoted to a consideration of the physiology of the Protozoa, with especial reference to the Protozoa as *organisms* endowed with the powers of coordination and of adaptation, which up to the present time have eluded physical and chemical analysis."

In pursuing this general plan the author has consistently resisted the temptation of involving himself in undue detail, and it is evident that he has everywhere striven to give proper shape and proportions to his work. In some parts of the volume, however, this brevity almost borders on meagerness and obscurity. The student who has long been irritated by the unsatisfactory text book accounts of the life-histories of the Sporozoa will certainly wish that Dr. Calkins had expanded his excellent chapter on these organisms and introduced a fuller account of recent works on the Gregarinida and Hæmosporidia. We miss, *e. g.*, an account of *Apiosoma bigeminum*, the source of Texas fever, and its transfer by the cattle-tick (*Boophilus bovis*) in a manner analogous to the transfer of *Plasmodium malariæ* by the mosquito (*Anopheles*). We should also have welcomed a fuller treatment of the geographical distribution of the Protozoa in general, their modes of dissemination and the phenomena of anabiosis.

Many morphologists and physiologists will wish that the author had dealt more critically with the conception of 'rejuvenescence,' a conception which smacks of 'Naturphilosophie' and is at most only an anthropomorphic 'Photographie des Problems.' The facts of parthenogenesis, both natural and artificial, appear flatly to contradict the assumption of Maupas and others that the temporary or permanent union of two exhausted cells results in one or two rejuvenated ones. This view was repudiated by Weismann on very good grounds several years ago.

The work of Calkins contains a classification of the Protozoa carried out to the families and genera. Unfortunately it is appended to three separate chapters and printed in such a form as to violate the very first rules of taxonomy. Classes, sub-classes, orders and suborders are all introduced in the same style of type and the various groups are coordinated in such a manner as to render a rapid and easy survey of the classification difficult, if not impossible. Taxonomy is the quintessence of our present morphological knowledge, and it is time that the prejudices of the narrow-gauge morphologist be not still further fostered by negligence in tabulating the essentials of the very science to which he is devoting himself with the characteristic myopia of one who sees not the forest because he is studying the venation of its leaves.

The volume is written throughout in a good, orderly style. Words like 'mononucleate' and 'unshelled,' in the sense of 'shell less' are conspicuously rare. The illustrations are clear, though occasionally too coarse for representations of such minute organisms. This is very

noticeable when they are compared with the delicate figures of Bütschli. Scarcely more than one tenth of the figures are original, and although the author has endeavored to avoid the commonplace in his selections from other writers, there is still a goodly array of the old and tiresome figures which seem to be as immortal as the Protozoa they represent, if one may judge from their perpetual metempsychoses in our zoological charts and text-books. The volume closes with an extensive, but by no means complete, bibliography and a good double index.

There can be no doubt that the volume should and will find a place in all our laboratories as a handy compendium of a marvelous group of organisms of basic importance in all our work in zoology, physiology and comparative psychology.

W. M. Wheeler.

Annual Report of the Chief of the Bureau of Steam Engineering. 1901. Washington, Government Print. 1901. 8vo. Pp. 70.

Admiral Melville reports in this document upon the condition and progress of the engineering branch of the United States navy, its personnel and material. The report is concise, clear, frank and illuminating. This Bureau has charge of all the machinery, of the navy, designs the engines, the boilers and machinery of the naval fleet, writes the specifications and contracts for such as may be built by private constructors, supervises the construction, makes the tests of completed machinery and has charge of the maintenance and repair of all such machinery. It expends $3,000,000 to $4,000,000 each year, mainly in repairs and preservation of the engines and boilers of the fleet. Of this work the report gives a detailed account, which is, however, not of special interest to the layman.

The new Naval Academy buildings, now under construction, are expected to cost about $7,000,000. Admiral Melville asks that, of this total, about $250,000 be applied to the construction of a laboratory for research in the physical sciences having direct application in engineering and marine construction. The building is to be two stories in height and 150 by 110 feet in plan, conforming in style of architecture to the buildings, planned for the Academy, now in progress. It is proposed to appropriate $150,000 for its equipment. This enterprise, if perfected, is another step in the direction of conforming the plan and workings of the Naval Academy to those of the great technical colleges of the world, and especially in the incorporation into its curriculum of experimental work in research as well as professional instruction.

With the resources of the general government available, the comparatively small expenditures needed to make the military and naval academies professional schools of the highest class, not only, as previously, in their organization and administration, but also in their equipment and in a complete and thoroughly modern curriculum, should be readily obtained, and these schools should take their rightful places as ideal, representative and model professional schools, in the extra-professional departments as well as in those which are purely vocational. In the applied sciences, particularly, they should be made perfect exemplars of the type which every civil as well as naval and military institution of learning should approximate as closely as means and the character of its faculty may permit.

Admiral Melville is pioneering here as effectively as when within the arctic circle and more usefully than ever did any explorer. He demands that the scientific departments of the Naval Academy, and especially the professional engineering division, be 'placed upon an equality with several universities whose colleges of mechanic arts and science in equipment far surpass the engineering outfit of the academy plant.'

The staff for this laboratory is to be organized from cadets and their teachers with, perhaps, one of the officers of the old engineer corps as its director. It is not only to be used in the investigation of the technical problems of the engineer department and of the naval service, but in the furtherance of the schemes of inventors where promising to be useful to the government or the public, also in testing all the appliances related to naval work; the materials and apparatus purchased by the Navy Department; and in the investigation of

especially important questions, such as relate to the economy of liquid fuel, the value of the steam turbine, the form and proportions of propellers, the use of electricity and the value of electric apparatus and transmissions, the causes and preventions of corrosion of boilers, condensers and machinery, the best forms of boiler, the balancing of engines, the development of a storage battery suitable for naval use and the use of compressed air and of gas and oil engines.

The splendid work of the laboratories of the colleges and technical and professional engineering schools of our own country and, particularly, of Germany is referred to as illustrating the promise of this enterprise.

The Chief of Bureau devotes some space to the subject of the personnel and the organization of the naval establishment, stating that the 'Personnel bill' has thus far failed of complete and satisfactory result and asserting that it can only be expected that its purpose will be effected when the officers of the navy of every class cordially unite to carry its provisions into effect completely and efficiently. He quotes Mr. Roosevelt, who, in the original report upon this plan, asserted 'every officer on a modern war vessel has to be a fighting engineer.'

The union of the engineer corps with the line of the navy, however, has not been a complete success, so far as intended to provide the service with a body of officers equally at home above and below decks and capable of efficiently handling the great 'war-engine' in its every department and detail. The young officers should be given large and responsible charge of work in the engineering departments and trained as experts; otherwise that failure which was anticipated by many friends of the navy during the discussion of the bill, as a possibility if not a probability, must be looked for as certain.

It is stated that for every three officers taken from the engine-room for duty on deck, only one has been transferred from deck to engine-room, and the vitally essential care of motive power is coming thus to be impossible; unless, indeed, a radical change of method be adopted. The 'engineer's war-engine,' according to Roosevelt, must be in the care, each in his province, of a crew of officers and men competent, individually as well as collectively, to handle its complicated and costly machinery with efficiency and economy. Thus far the new provision of law has not insured even the maintenance of the former efficiency of the great machine. The condition is critical and the Chief of Bureau shows courage as well as discretion in his discussion of the subject.

R. H. THURSTON.

Roscoe-Schorlemmer's Lehrbuch der organischen Chemie. Von JUL. WILH. BRÜHL, Professor an der Universität Heidelberg. Sechster Theil, bearbeitet in Gemeinschaft mit Eduard Hjelt und Ossian Aschan. Braunschweig, Friedrich Vieweg und Sohn. 1901. Pp. xxxix + 1045. Price (bound), M. 24.

This is the eighth volume of the German edition of Roscoe and Schorlemmer's 'Treatise on Chemistry,' and is the sixth part of the portion dealing with organic chemistry. It includes a consideration of the vegetable alkaloids, glucosides and bitter principles, natural coloring matters, chlorophyll, lichen substances and such indifferent bodies of vegetable origin as have not been considered in previous volumes.

Somewhat more than one half of the volume is given to the alkaloids. The primary classification of these is based on the group characteristic of their structure. This gives the pyrrolidine, pyridine, quinoline and isoquinoline groups and a group containing alkaloids of unknown structure. Within each group they are further classified in accordance with the plant or family of plants from which they are derived, this latter classification depending on the well-known fact that alkaloids found in the same plant, and often those found in different plants of the same family, usually have closely related structures.

About one fourth of the book is given to the glucosides and about eighty pages are given to chlorophyll and the same number to lichen substances. The discussion of chlorophyll is especially full and satisfactory and includes a good bibliography of the subject. In this portion, especially, the needs of the biologist as well as of the chemist have been considered.

The general plan of the work includes a historical account of the discovery and study of the more important substances considered. While it lays no claim to that exhaustive completeness in detail which is characteristic of Beilstein's Handbook, it is much easier to secure from it a knowledge of the present views of the structure of particular compounds, and of the basis on which such views rest. Considerably more space is given to the alkaloids than is devoted to the same topic in Beilstein. The book covers the literature of its subject up to a very recent date and the information to be found in it is very reliable and satisfactory.

W. A. NOYES.

SCIENTIFIC JOURNALS AND ARTICLES.

THE first number of the first volume of the *American Journal of Anatomy* was published on November 7, its contents being as follows:

'The Development of the Limbs, Body-wall and Back': CHARLES RUSSELL BARDEEN and WARREN HARMON LEWIS.

'The Intralobular Framework of the Human Spleen': PRESTON KYES.

'Studies on the Neuroglia': G. CARL HUBER.

'The Normal Histology of the Human Hemolymph Glands': ALDRED SCOTT WARTHIN.

'On the Morphology of the Pineal Region, based upon its Development in *Acanthias*': CHARLES SEDGWICK MINOT.

THE editorial board, consisting of Lewellys F. Barker, University of Chicago; Thomas Dwight, Harvard University; Simon H. Gage, Cornell University; G. Carl Huber, University of Michigan; George S. Huntington, Columbia University; Franklin P. Mall, Johns Hopkins University; Charles S. Minot, Harvard University; George A. Piersol, University of Pennsylvania; and Henry McE. Knower, Secretary, Johns Hopkins University, have sent with the first number the following prospectus: *The American Journal of Anatomy* has been founded to collect into one place, and present in a worthy manner, the many researches from our investigators, now scattered through many publications at home and abroad. Human anatomy in America needs as high a standard of reference as it has in other countries. Without such a standard it fails to make for itself any proper, satisfactory or stimulating impression. The best interests of modern scientific medicine will be greatly advanced by the upholding of such a standard in this fundamental subject through a journal of high character. Many aspects of comparative anatomy, embryology, histology and cytology are so intimately bound up with the problems of human anatomy that these subjects will be included within the scope of the new journal. It will be the aim of *The American Journal of Anatomy* to recognize this close natural relationship between the various branches of the science, and to publish results of the best original work of American students of anatomy. The most cordial assurance of support has been given by the collaborators, and this we believe is sufficient indication of the results to be expected. A number of generous persons, whose names will appear later, have given some financial support to help us in gaining a foothold in a suitable manner. The journal must, however, look to those who are to be benefited by its publication for its real and permanent support; and a good list of regular subscribers is expected and required to maintain it. It is hoped that those interested in promoting a worthy development of research in America, in the subjects included within the scope of this journal, will energetically assist us.

THE October number of the *American Geologist* contains a number of interesting articles. John A. Dresser writes on 'The Petrography of Shefford Mountain.' The mountain discussed is one of a series of volcanic hills in the St. Lawrence Valley about fifty miles east of Montreal, Canada. The author concludes that the mountain is a laccolith, and that it contains three different flows represented by three different classes of rocks, viz: essexite, nordmarkyte and pulaskite. 'Paleontological Speculations,' by S. P. Gratacap is a continuation of a discussion begun in a number of a preceding volume. Mr. Warren Upham discusses 'Niagara Gorge and Post Glacial Time,' in which he gives some reasons based on recent investigations for estimating the duration of the Niagara River at 7,000 years. It is claimed that this estimate is more in harmony with estimates from other sources by Winchell,

Andrews, Emerson and others, than the longer period usually ascribed to this work. A 'Note on Certain Copper Minerals,' by A. W. Winchell, describes chalcopyrite and bornite found as an accidental furnace product replacing the iron rails in a calciner at a copper mine in Montana. The editorial comment includes an obituary notice with a short biography of Edw. W. Claypole, of Pasadena, California.

THE first number of a journal devoted to biological chemistry, entitled *Beiträge zur chemischen Physiologie und Pathologie—Zeitschrift für die gesammte Biochemie*, and edited by Dr. Franz Hoffmeister, professor of physiological chemistry at Strassburg, was issued recently. Its appearance may be interpreted as the outcome of the increasing application of chemical methods to the solution of biological and pathological problems.

SOCIETIES AND ACADEMIES.

NATIONAL ACADEMY OF SCIENCES.

THE National Academy held its autumn meeting at the University of Pennsylvania, Philadelphia, on November 12, 13 and 14. The papers entered to be read were as follows:

'Note on Linear Force exerted by Growing Crystals': GEORGE F. BECKER.

'Note on the Orogenic Theory of Tilted Blocks': GEORGE F. BECKER.

'On the Vaso-motor Supply of the Lungs': HORATIO C. WOOD, JR. (Introduced by George F. Barker.)

'Biographical Memoir of Frederick Augustus Genth': GEORGE F. BARKER.

'On the Pseudo-catalytic Action of Concentrated Acids': JAMES M. CRAFTS.

'On the Use of the Stereographic Projection in Making Accurate Maps; with Criticism of some Recent Methods of Map Projection': SAMUEL L. PENFIELD.

'On the Logic of Research into Ancient History': CHARLES S. PEIRCE.

'Observations on Tungsten': EDGAR F. SMITH.

'The Monatomic Gases': GEORGE F. BARKER.

'Snake Venom in Relation to Hæmolysis, Bacteriolysis and Toxicity': S. WEIR MITCHELL and SIMON FLEXNER.

'The Tendency of Complex Chemical Radicals to control Crystallization because of their Mass Effect; a Study in Isomorphism': SAMUEL L. PENFIELD.

'On the Nature of the Double Halides': IRA REMSEN.

'Biographical Memoir of General John Newton': CYRUS B. COMSTOCK.

'Dolichocephaly and Brachycephaly as the Dominant Factors in Cranial Evolution': HENRY F. OSBORN.

'Cranial Evolution of *Titanotherium II.*': HENRY F. OSBORN.

'Latent or Potential Homology': HENRY F. OSBORN.

'A New Gauge for the Direct Measurement of Small Pressures': EDWARD W. MORLEY and CHARLES F. BRUSH.

'Transmission of Heat through Vapor of Water at Small Pressures': EDWARD W. MORLEY and CHARLES F. BRUSH.

'On the Newer Forms of Incandescent Electric Lamps': GEORGE F. BARKER.

'On Quadrant Electrometry with a Free Light Needle highly charged through a Conductor of Ionized Air': CARL BARUS.

'On Nuclear Condensation in the Vapor of Non-Electrolytes like Benzene; and on Graded Condensation': CARL BARUS.

'The Work of the International Association of Academies': HENRY L. BOWDITCH.

'A Method of Rearing Marine Larvæ': CASWELL GRAVE. (Introduced by William K. Brooks.)

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis, on the evening of November 4, 1901, Professor Alexander S. Chessin spoke 'On the Motion of a Top, taking into Account the Rotation of the Earth,' giving an abstract of his researches on the earth's rotation as manifested in the motion of bodies on its surface, the details of which he hoped to present shortly in a series of papers.

Two persons were elected to membership in the Academy. WILLIAM TRELEASE, *Recording Secretary.*

THE ELISHA MITCHELL SCIENTIFIC SOCIETY.

THE 137th meeting of the Society was held on November 12, 7:15 P. M., in the chemical lecture room, Person Hall, University of North Carolina. The following papers were read:

'A Short Cut Percentage Calculation': E. V. HOWELL.

'Cold Light': J. W. GORE.

CHAS. BASKERVILLE,
Secretary.

DISCUSSION AND CORRESPONDENCE.

PHYSIOLOGICAL EFFECTS OF DIMINISHED AIR PRESSURE.

To the Editor of Science: In a communication published in Science for November 1 (p. 696), Mr. H. H. Clayton, of Blue Hill Observatory, gives some observations on the number of his pulse-beats, noted during a recent ascent of Pikes Peak by railroad. The pulse increased from 78 beats per minute at Manitou (6,662 ft.) to 92 at the summit of the mountain (14,147 ft.). Mr. Clayton's note recalls some similar observations made by the writer in Peru in 1897, during two ascents of El Misti (19,200 ft.), then the site of the highest meteorological station in the world, established by Professor S. I. Bailey, and operated by the southern station of the Harvard College Observatory at Arequipa. Both ascents were made on mule-back, so that no physical exertion was necessary. The first ascent was on October 7, the start being from the Observatory (8,050 ft.) on October 6. Although provided with clinical thermometers and with a sphygmograph, the writer suffered so severely from mountain sickness that he made very little use of his instruments. His temperature at 5:30 p. m., October 5, twelve hours before leaving Arequipa, was 98°.4; his respiration 24, and his pulse 90. On the summit of El Misti the body temperature was 96°.4; the respiration 34, and the pulse 110. Twelve hours after arrival at Arequipa the figures were 98°.0, 24 and 85 respectively. A rather unsatisfactory sphygmograph curve was obtained on the summit.

The second expedition to El Misti was made on November 9, 1897, and on this trip the writer suffered much less from mountain sickness than on the previous one. At an altitude of 15,700 ft. a short walk of about 100 yards was taken to the instrument shelter. Two stops were necessary on the way, to get breath. An hour after this exercise, the pulse was 128, the body temperature 97°.0, and the respiration 30. The corresponding figures twelve hours before leaving Arequipa were 91, 98°.6 and 20. The night was spent at 15,700 ft. The body temperature immediately after waking in the morning was 96°.2; the pulse 112, and the respiration 30. Twenty minutes after reaching the summit, the temperature was 97°.2, the pulse 120, and the respiration 32. In an hour and a half the respiration was 35, the pulse and temperature remaining the same. In two hours the temperature was 96°.8, the pulse 112, and the respiration 34. Three fairly good sphygmograph curves were obtained on the summit. These curves possess some interest as being, so far as I have been able to learn, the first, with possibly one exception, to be secured at so great an altitude as 19,200 ft. At any rate, no curve from so great an altitude was reproduced until a copy of one of these tracings from the Misti summit was printed in an article by the writer in the *Journal of the Boston Society of Medical Sciences* for June, 1898.

On the second expedition to El Misti the descent was begun two hours and a half after reaching the top. At the hut at the base of the mountain (15,700 ft.), after walking to and from the shelter, the pulse was 130, but the respiration had decreased to 30. One hour after arriving at Arequipa the temperature was 98°.2, the pulse 116, and the respiration 22, and twelve hours after arrival the pulse had fallen to 82—about the writer's normal at the Observatory—and the respiration to 22, the normal being 20.

In counting the pulse on the summit it was quite unnecessary to place the finger on the wrist. The heart-beats could plainly be *heard*.

R. DeC. Ward.

Harvard University,
November 2, 1901.

PRACTICAL AMELIORATIONS OF ENGLISH GRAMMAR.

Every year or so a 'practical grammar' of our mother-tongue is announced as on the eve of publication, and, when the book appears, every teacher and student who had been hoping for some real progress in ridding the language of the impedimenta of barbarism and the useless paraphernalia inherited from classical schematism, experiences a keen sense of disappointment.

Perhaps the greatest intellectual feat so far accomplished by English-speaking peoples all over the globe has been to free their mind-tool so largely from the shackles of grammar. So much having been done already in this direc-

tion, we ought to make further advances toward ideal speech. All such advances will serve English well in the struggle for adoption as the world-language, for the more cosmopolitan, the less grammatical, in the classical sense, must it be.

It needed no prophet to foretell the fate of Latin as a would-be international tongue. In the nature of the case, it could never be more than the artificially propagated and sustained speech of more or less extensive and widely scattered societies, cliques, clubs and associations (political, religious, scientific, etc.), for the mind of the Aryan and Semitic races was capable of something higher than speaking through a death-mask, and other populous nations have also to be reckoned with—nations like the Chinese, Japanese, Malays, Hindus—who cannot be expected to welcome a dead language over against a live one. Evolution, too, has written a like epitaph over Greek, which some enthusiasts would fain have us accept as a universal language. No such backward step is probable or even possible. Against all competitors in the field, English is favored by its increasing degrammatization and the open hospitality it extends to new words from every language under heaven.

Phonetic spelling must triumph in the end, and as complete a victory waits also for free speaking and free writing—*i. e.*, language untrammeled by grammatical artificialities. Not a backward-looking Volapük, but English with its face to the future foreshadows the true world-language. Phonetic spelling has already made a good beginning, which suggests the possibility of similar intentional reforms in English grammar. The present writer will content himself with specifying certain ameliorations of grammar, which, perhaps, may serve, like the ten 'rules' for amended spelling proposed in 1883 by the English and American Philological Associations, or the list reported by the American Committee in 1886, as starters for more ambitious movements of reform.

The list is as follows:

1. Drop the so-called *subjunctive mood* altogether. It is moribund in much of our best prose, and can be allowed to die out of our poetry with no injury to rhyme or reason, strength or beauty.

2. Drop *inflected forms for the past tense and past participle*, making all new verbs, whether introduced from foreign tongues or made within the language itself, conform to the type of *hit*, *let*, etc. In America, in particular, drop *gotten*.

3. Avoid the use of *differing forms for verb and noun*. Follow the model of *boycott*, under 'rule' 2.

4. Avoid the use of *plural forms of nouns*, making all new substantives, whether borrowed from other languages or born of the mother-tongue, conform to the model of *sheep*, *deer*, etc.

5. Avoid the use of *Greek or Latin names for 'new things.'* Follow the good example of certain scientists, and name them after their discoverer, the place of origin, etc. Make new words here conform to the model of *gatling*, *ampere*, and the like.

6. Avoid the use of *feminine forms of nouns* previously employed with reference to males, letting the thought control the grammar. Drop particularly *authoress*, *poetess*, etc.

7. Avoid forming *adverbs by inflection*, using for all new words of this class the same form for adjective (or other word) and adverb.

8. Omit the conjunction *that* wherever possible. For example, in such cases as 'I know *that* he is dead.'

9. Use *but* and *as* as full-fledged prepositions.

10. Drop *whom*, using *who* for both cases.

11. Ceasing the attempt to distinguish between *who* and *that*, and *that* and *which*, let the fittest survive in each instance.

12. Use the pronouns compounded of *self* and their plurals, both as subjects and objects.

13. Drop the *apostrophe* in the *possessive case*.

Other suggestions might be made, but these cover sufficient ground for the present.

ALEXANDER F. CHAMBERLAIN.
CLARK UNIVERSITY, WORCESTER, MASS.

SHORTER ARTICLES.

CATALASE, A NEW ENZYM OF GENERAL OCCURRENCE.

THE study of the enzyms has been pursued with growing interest by a number of scientists during later years. These unorganized ferments being substances of a highly ephemeral

nature, the method of investigating them has departed somewhat from the paths usually followed in determining the composition, effects and rôle, of organic combinations in vegetable and animal organisms. The nature of the enzym is still a matter of much doubt. Of their action we are more sure, and it is along this line that we have become familiar with the nature of some members of this very interesting group of compounds. The rôle of the enzym in the life processes may also in some cases be defined with certitude.

Beginning with a few, the study of unorganized ferments has brought to light many others. Out of the growing number some are already put to important uses, while others bid fair to become of great value to many industries. Dr. Oscar Loew in his studies on tobacco (Rpt. No. 68, Div. of Veg. Phy. and Path. U. S. Dept. of Agr.) goes further in the study of unorganized ferments than ascribing to one a special rôle and shows the general distribution and seeks a reason for its existence of an enzym, to which he gives the name catalase.

In the work with this enzym, in which the writer took some part, the most striking characteristics were its very general dissemination, its persistence, and its ability to break down hydrogen peroxid. In the examination of a large number of animal and vegetable organs this enzym was found present, in greater or less amount, in every instance. Its differentiation from other unorganized ferments is established by a large number o tests with various reagents. Among other characteristics it was found to be more persistent than any other known enzym. This was especially noted in dried vegetable substance as seeds and leaves, being found present in a herbarium specimen of the latter examined after a lapse of over 50 years.

The ability of catalase to break down hydrogen peroxid appeared to be its most striking peculiarity, and this led the author to believe that it might perform such a service in the phenomena displayed by living matter. Tests go to show that it belongs to the class of oxidizing enzyms and its very general occurrence and uniform actions indicate that it plays some important rôle in physiological processes.

From his studies the author gives the following as the most plausible explanations of the action of catalase in vegetable organism: (1) It destroys instantly the hydrogen peroxid, probably formed in cells during the oxidation caused by the respiration process; (2) it loosens chemical affinities in certain compounds so that the protoplasm can more easily split or oxidize them. "In other words, catalase might represent an aid for fermentative as well as for respirative phenonomena."

D. W. MAY.

U. S. DEPARTMENT OF AGRICULTURE.

TOADS KILLED BY SQUASH-BUGS.

DURING the past summer the Entomological Department of the New Hampshire College Agricultural Experiment Station carried on investigations on the common squash-bug (*Anasa tristis*), which has been so abundant in some portions of the State the past season. Mr. Kirkland, in Bulletin 46, Mass. Agr. Exp. Sta., recorded the bug to have been found in the stomach contents of toads; Mr. Chittenden, in Bulletin 19, 1899 (New Series), U. S. Dept. Agr., states that Dr. Judd likewise found a bug in a toad's stomach. This suggested that the toad is probably an enemy of the squash-bug, and experiments, made to determine this, showed the following interesting results: When a squash-bug nymph o the fifth stage was suddenly introduced into a half pint, open, wide-mouthed specimen jar containing a half grown live toad, so that the Batrachian would get the full effects of the pungent fumes given off by the bug, the toad was thrown into a temporary stupor, the effect being similar to that of chloroform. As the number of bugs was increased the effect on the toad was increased. When as many as seven bugs were introduced the toad fell into a profound stupor and died in the course of twenty-four hours.

On September 8, an adult, that had been kept in the laboratory vivarium with a scant food supply for several days, was placed in a quart jar of the same construction as the one mentioned above, and eight bugs were introduced; these bugs, however, had been so much disturbed previously that the source of the pungent secretion had been temporarily exhausted. The toad hesitatingly devoured three, after

which she would remove with her front feet every specimen that made an attempt to ascend the wall of her enclosure; but these bugs were not eaten. The toad was then transferred to another jar of the same size and construction and eight bugs were suddenly introduced from the squash leaf so that the toad would get the first and fullest effects of the odor; the result was that the animal went through a series of contortions followed by a short period of stupor similar to that mentioned before. Upon recovery the toad was again removed to the vivarium where it now lives in partial hibernation.

A young red spotted salamander was affected and killed as easily as the half-grown toad, while for the common field frog a greater number of bugs were required to bring about similar effects, the frogs also being killed. Many experiments with snakes were tried, but no ill effects from the secretion of the bugs were apparent.

The odor that the bug gives off emanates from a clear, slightly greenish liquid expelled from the extremity of the alimentary canal; when it comes in contact with the air the odor is given off almost instantaneously while the liquid remains to evaporate.

These experiments are still in progress and when completed will be published in detail. They seem to open up an interesting field for investigation as to the protective value of the odoriferous secretions of many of the Heteroptera.

ALBERT F. CONRADI.
NEW HAMPSHIRE COLLEGE AGRICULTURAL EXPERIMENT STATION, DURHAM,
October 29, 1901.

CURRENT NOTES ON METEOROLOGY.

THE WEATHER BUREAU.

THE address presented at the Convention of Weather Bureau officials, held at Milwaukee last August, by Professor Willis L. Moore, Chief of the Weather Bureau, is printed in the October number of the *National Geographic Magazine.* The salient facts in the history of the weather service are given, and special emphasis is laid on the tangible results of the Weather Bureau's work. It is a pleasure to see the name of Professor Cleveland Abbe, the foremost living American meteorologist, linked with the names of Redfield, Espy, Maury and Loomis in this article. Some of the statistics given by Professor Moore are worthy of note here. Thus, in the case of cold-wave warnings, the statement is made that 100,000 telegrams and messages are frequently distributed within a few hours. During one cold wave $3,400,000 worth of property is estimated to have been saved as a result of the information issued by the Weather Bureau. The system of distributing warnings of gales dangerous to navigation is so perfect that "the Chief of the Weather Bureau, or the forecaster on duty at the Central Office, can dictate a storm warning and feel certain that inside of one hour a copy of the warning will be in the hands of every vessel master in every port of material size in the United States, provided that it is his desire that a complete distribution of the warning be made."

Reference is made to the important work of the Bureau in connection with measurements of snowfall in the high mountains of Montana, Wyoming, Idaho, Utah, Arizona and New Mexico, which make it possible to estimate the probable supply of water to be expected for irrigating purposes, and also to the recently inaugurated forecasts of wind direction and velocity for a period of three days after steamers sail from European or North American ports. At the conclusion of his article, the Chief of the Weather Bureau rightly criticizes the press for the attention it gives to the long-range forecast frauds, which deceive so many persons. Last year's appropriation of $1,058,320 for the Weather Bureau was certainly small, considering the value of the work done.

MONTHLY WEATHER REVIEW.

THE *Monthly Weather Review* for July (issued in October) contains the usual number of interesting articles. In 'The Thunder-storm: A New Explanation of one of its Phenomena,' Byron McFarland gives his reasons for not accepting the common explanation of the origin of the squall wind in thunder-storms, viz., that this squall is due to the 'kick' of the rapidly ascending air, and advocates the theory that the cool air within the thunder-storm accounts for

the phenomena of the outflowing squall. A. L. Rotch contributes a short account of a meteorological balloon ascension in which he took part at Strassburg last July. Professor R. E. Dodge describes some diurnal winds in northwestern New Mexico, which are developed on very faint gradients. A translation, by Professor Cleveland Abbe, of the introduction to Marcel Brillouin's recent volume 'Mémoires Originaux sur la Circulation Générale de l'Atmosphère,' brings before American readers an excellent brief historical summary of the various important contributions made by Ferrel, Thomson, Siemens, and others, to the subject of the general circulation. 'Yukon Weather' is the title of a paper by U. G. Myers, Section Director of the Weather Bureau in Alaska. Professor Abbe, in his 'Notes by the Editor,' discusses the relation between the scientific work of the Weather Bureau and the long-range forecasts made by those who believe in lunar or stellar influences, and in this connection gives a translation of the paragraphs of Angot's 'Traité de Météorologie' which deal with this subject. An account of the Milwaukee convention of Weather Bureau officials concludes this number of the *Review*.

GEOLOGICAL CHANGES OF CLIMATE IN THE EASTERN CORDILLERAS.

A RECENT paper by Professor N. S. Shaler, on 'Broad Valleys of the Cordilleras' (*Bull. Geol. Soc. Amer.*, Vol. 12, 271–300), explains certain features of these valleys by an increased erosive action due to an ancient temporary increase of rainfall in preglacial time. The source of the larger part of the rainfall in the Mississippi valley drainage area is evidently in the basin of the Gulf of Mexico and the Caribbean Sea. When these waters were of greater extent, the evaporation from them might well have produced a much heavier rainfall over the Cordilleras than is now found there. There is evidence in the broad valleys of several oscillations of climate. At the present time the conditions of the eastern section of the Cordilleras indicate a recent return to an arid climate. The taluses are evidently increasing. "Unless the Gulf of Mexico," Professor Shaler concludes, "should again be brought over a considerable part of the southern lowlands, there seems to be no reason to expect that there will be any increase of rainfall in this area."

TREE PLANTING ON THE PRAIRIES.

WILLIAM L. HALL, assistant superintendent of tree planting in the Division of Forestry, believes that the time has come for an extensive development of forest plantations throughout the Middle West, in consequence of the rapid diminution of the supply of natural timber in the Mississippi valley (Yearbook Dept. of Agriculture for 1900). Over extensive areas the prices of posts, telegraph poles and cross-ties much exceed the cost of growing them. This difference promises profit in timber growing. Ten years ago the area for profitable tree planting was, chiefly for climatic reasons, thought to be much smaller than it is now known to be. The past year has seen the establishment of nearly 100 plantations by individuals in co-operation with the Division of Forestry, and during the present year more trees will be planted than ever before. Mr. Hall believes that if 500,000 acres of timber, well distributed throughout the Middle West, were planted annually, the production would still be inadequate to meet the demand, and liberal profits could still be hoped for. R. DEC. WARD.

PROPOSED AMERICAN ELECTRO-CHEMICAL SOCIETY.

A MEETING was held on November 1 at the rooms of the Engineers' Club in Philadelphia, to discuss the question of the advisability of organizing a national electro-chemical society on the same general plans as the American Chemical Society and the American Institute of Electrical Engineers. Some twenty or thirty persons from different parts of this country, who were thought to be interested in the subject of electro-chemistry, had been asked to be present or to express their views by letter. Among the communications received, the majority, especially from the electrochemical industries, were in favor of the formation of such a society; the minority thought the time had not come yet for such a society, that the American Chemical Society and the American Institute of Electrical Engineers filled the needs, that there were already a number of other societies at which papers on this subject could be read, etc.

Those present included representatives from New York City, from the Cornell, Lehigh and Johns Hopkins Universities, from the American Chemical Society, the American Institute of Electrical Engineers, the Franklin Institute, etc. Professor J. W. Richards, vice-president of the American Chemical Society, acted as chairman, and Carl Hering, past president of the American Institute of Electrical Engineers, as secretary. All those present were heartily in favor; the only doubt expressed was whether a sufficient number of members could be obtained to make such a society a success. A committee was appointed, with Dr. Chas. A. Doremus, of the College of the City of New York, as chairman, to canvass for members; and if seventy-five or over pledge themselves to join, the society will be formed. In that case, certain committees which were appointed will arrange for holding a formal meeting at which the society will be founded and papers read and discussed. Anyone desiring to become a member is asked to communicate with Dr. Doremus at the above address.

It was furthermore decided to be the expression of those present that the name of the organization should be the American Electrochemical Society; that the dues should not exceed $5.00 per year, and that at first only a few meetings of a few days each should be held per year, and that they be held in different cities, as the society is to be a national one.

The fact that papers on the subject of electro-chemistry are now scattered over a half dozen or more existing national societies was thought to be in itself a very good reason for bringing them all together into one, where they could then be properly discussed, which is not now the case. Attention was also called to the fact that the annual electro-chemical products of this country already amount to nearly $100,000,000, which is far greater than in all the other countries combined. Germany, which comes next with $14,000,000, has a flourishing electro-chemical society with about 40 members in the United States.

THE UNITED STATES NAVAL OBSERVATORY.

THE board of visitors of the U. S. Naval Observatory, consisting of Professors C. A. Young, C. F. Chandler, Asaph Hall, Jr., E. C. Pickering and Ormond Stone and President W. R. Harper, have recently held a meeting and submitted a report to Secretary Long. Extracts from the report published in the Washington *Evening Star*, are as follows:

"It is recommended that no astronomical director be appointed at present, as a dual headship has been found to work unsatisfactorily, and under the existing law the appointment of an astronomer as sole director of the observatory—which the board considers the proper solution of the question—is impracticable. Vacancies should not be filled among assistant astronomers nor among professors of mathematics in the navy without examination for each vacancy occurring. No distinction should be made between employees of the observatory and other applicants. The responsibilities of the positions of assistant astronomer and professor of mathematics are distinctly different from those of computer, although much of the required experience may properly be gained in connection with the latter position and be credited in the examinations for the higher positions. As far as is consistent with the routine needs of the institution, the duties of the computers should be so arranged as to encourage them to prepare for advancement within the observatory itself. In no case should appointments be made to the observatory merely by transfer from other bureaus or offices in the service, nor should appointments ever be made even temporarily without competitive examination."

Applying these principles to practice the board declines to name a person to fill the vacant office of assistant astronomer at the observatory and instead recommends that the appointment be made after a civil service examination under the auspices of the commission.

Coming to the more important subject of the actual head of the observatory, which involves the issue between the scientists and the line officers, the board says:

"As every other prominent observatory is under the direction of an astronomer, we wish to record our deliberate and unanimous judgment that the laws limiting the superintend-

ency to a line officer of the navy should be changed so as to provide that the official head of the observatory—perhaps styled simply the director—should be an eminent astronomer appointed by the President, by and with the advice and consent of the Senate, holding this place by a tenure at least as permanent as that of the superintendent of the coast survey, or the head of the geological survey, and not merely by a detail of two or three years' duration. Only in this way can there be a continuous and effective policy of administration which will insure astronomical work of a high order. In rank, salary, privileges and prestige he should be superior to any other official on the ground.

"The limitation in the selection of assistants should also be removed, and the assistant once appointed should be secure against detachment or removal except by the action, for cause, of the director. The institution should be related to the Navy Department, if continued under its control, in some such way as the Royal Observatory at Greenwich is related to the British admiralty. It should be put under the control of the secretary directly, and not through a bureau as at present."

In conclusion the Board finds objection to the manner in which appropriations have been made in support of the observatory, saying that it is not easy to determine what portion of the expenditures pertains properly to astronomical work, what portion to the naval work, and what portion to the improvement and care of the grounds as a part. The cost of maintenance for the last fiscal year was $108,428, of which amount $21,258 was expended in salaries.

SCIENTIFIC NOTES AND NEWS.

Dr. J. Willard Gibbs, of Yale University, has been awarded the Copley Medal of the Royal Society for his contributions to mathematical physics.

Henry M. Howe, professor of metallurgy at Columbia University, has been elected an honorary member of the Russian Technical Society at St. Petersburg.

Dr. E. A. de Schweinitz, dean of the Columbian University Medical School and director of the Biochemic Laboratory, U. S. Department of Agriculture, has recently been elected a corresponding member of the Epidemiological Society of London, and also of the 'Society for Combating Tuberculosis,' of Berlin.

Professor William F. Willoughby, recently expert in the U. S. Department of Labor and now of Harvard University, has been appointed treasurer of Porto Rico.

Professor Luigi Palazzo has been appointed director of the Central Meteorological and Geodetic Institute at Rome.

Dr. von Wettstein, of the University of Vienna, who was sent by the government to study the flora of Brazil, has returned.

It is stated by the Berlin correspondent of the *Times* that Professor Paul Ehrlich, of Frankfurt-on-the-Main, has been enabled to devote himself to a special study of the disease of cancer in consequence of a bequest of the interest for three years of a sum of 500,000 Marks dedicated to this purpose by a Frankfurt banker, the late Herr Theodor Stern. Other sums contributed by private individuals will bring up the amount to be devoted to this special investigation of cancer by Dr. Ehrlich to 40,000 Marks, or $10,000 a year. In Berlin there exists a special committee for the investigation of cancer, which studies pathological accounts of cases and collects statistics and medical literature on this subject. Professor von Leyden is at the head of the committee, and Professor von Kirchner, of the medical department of the Ministry of Public Instruction, is one of its members.

The Craig Colony Prize of $200 has been awarded to Professor Carlo Ceni, of Pavia, Italy, for an essay, entitled 'Serotherapy in Epilepsy.'

At the scientific meeting of the Zoological Society of London, on November 19, papers were read by Professor Ray Lankester, on '*Okapia*, a New Genus of Giraffidæ from Central Africa,' and by Mr. Oldfield Thomas 'On the Giraffe discovered by Sir Harry Johnston near Mount Elgon, Central Africa.'

The work of putting in place at Wood's Holl a boulder to serve as a memorial to the late Professor Spencer F. Baird is now completed.

The erection of this monument is the outcome of the action of the American Fisheries Society at a meeting held at Wood's Holl in the summer of 1900, when resolutions presented by Dr. H. M. Smith, providing for an appropriate memorial to Professor Baird, were unanimously adopted. The boulder is of granite, weighs about six tons, and was taken from the shores of Nonamesset Island by permission of Mr. J. Malcolm Forbes, whose father, the late John Murray Forbes, manifested great interest in the establishment and work of the station. The memorial will be completed when a suitably inscribed artistic bronze tablet is attached to the stone. This will probably be deferred until next spring.

A MEDALLION in memory of Dr. W. Kühne, formerly director of the Physiological Institute, was unveiled at the University of Heidelberg on October 20.

PROFESSOR RICHMOND MAYO-SMITH, since 1883 professor of political economy and social science at Columbia University, died, as the result of a fall, on November 11. He was born in Ohio in 1854 and graduated from Amherst College in 1875. Professor Mayo-Smith was the author of numerous important contributions to statistics and other departments of political economy, including books on 'Emigration and Immigration (1890), 'Sociology and Statistics' (1895) and 'Statistics and Economics' (1899). He was the only representative of political science in the National Academy of Sciences.

THE death is announced of Professor Ralph Tate, since 1876 professor of natural science in the University of Adelaide. He was the author of numerous papers on geology and zoology and was in 1893 president of the Australasian Association for the Advancement of Science.

DR. ALEXANDER HUGHES BENNETT, the eminent physician, known for his work on diseases of the nervous system, died in London on November 1, at the age of fifty three years. On his special subjects of epilepsy and paralysis he had written largely, and was the author of the well-known 'Practical Treatise on Electro-diagnosis in Diseases of the Nervous System,' and of the smaller text-book founded upon that work.

MR. HENRY SPENCER SMITH, one of the original fellows of the Royal College of Surgeons, London, died on October 29, at the age of eighty-eight years. Mr. Smith was secretary to the first government inquiry into the pathology and treatment of contagious diseases, and was a fellow and formerly vice-president of the Royal Medico-Chirurgical Society. He contributed frequently to the medical journals and translated several works, including Professor Schwann's work on 'Microscopical Researches into the Accordance in the Structure and Growth of Animals and Plants,' which obtained for its author, in 1845, the award of the Copley Medal of the Royal Society of London.

WE also regret to record the deaths of Dr. Marcel Nencki, professor of biological chemistry in the University of St. Petersburg, at the age of 56 years; of Professor Max Märcker, director of the Agricultural Experiment Station at Halle, at the age of 59 years, and of Professor Miguel Colmeiro, director of the Botanical Gardens at Madrid, at the age of 86 years.

MR. ANDREW CARNEGIE has given $1,000,000 as an additional endowment of the Carnegie Institute and has added $1,000,000 to the million dollars he has already given toward an endowment of the Carnegie Polytechnic Institute, to be erected at Pittsburg. Mr. Carnegie has also offered $50,000 to Springfield, Mo., for a free public library building.

A NEW YORK State civil service examination will be held in various cities throughout the State on or about December 7, 1901, for the position of director of the New York State Pathological Institute, with a salary of $5,000. The subjects and weights for the examination are: Pathological anatomy of the nervous system, technique and methods of neural investigation, architecture of the nervous system and lines of research to be applied to the study of the pathology of insanity, 8; experience, 2. The position is open to non-residents of the State, subject to the provision that if the eligible list contains the names of three or more persons who are citizens and residents of New York State, such persons shall be preferred in certification over non-residents. Examinations will also be held for the positions of assistant

in the Antitoxin Laboratory, and assistant bacteriologist, both in the Department of Health, at salaries of $750 and $500, respectively. The former position is open only to women, and subjects of examination and their relative weights are as follows: Bacteria, their nature, position among other living objects, functions, classification, principles of bacteriological manipulations, methods of making and testing culture media, sterilization of instruments and media, preparation of diphtheria toxin, etc., 8; experience and education, 2. The position of assistant bacteriologist is open only to licensed medical practitioners of New York State. The incumbent must give half his time to the work, which must be the first charge on his time. The examination will cover general knowledge of bacteriology and special knowledge of the methods and problems of the preparation of diphtheria and other antitoxins.

THE U. S. Civil Service Commission announces that at the request of the Board of Visitors to the United States Naval Observatory, an examination will be held on December 11, 12, 13, 1901, at various places throughout the United States, for the position of assistant astronomer in the U. S. Naval Observatory, at a salary of $1,800 per annum.

The subjects and weights are:

Pure mathematics, practical and spherical astronomy, celestial mechanics, general mechanics, optics, and French and German	20
Experience (*a*) in making astronomical observations, (*b*) in making astronomical computations, (*c*) in making and repairing, mounting and dismounting, and in caring for astronomical instruments, including auxiliary apparatus	40
Ability to carry on original astronomical investigations, as evidenced by printed or written memoirs, certificates, etc	40
Total	100

The examination on the technical subjects first named will be entirely of a scholastic character and will occupy three days. Under the second and third subjects applicants will be expected to submit evidence of their experience and ability. This evidence should be full and complete. Age limits, 20 to 45 years.

A TELEGRAM has been received at the Harvard College Observatory from Professor W. W. Campbell at Lick Observatory stating that from a Crossley photograph, Professor Perrine finds that four principal condensations in faint nebula surrounding Nova Persei moved southeast one minute arc in six weeks. Professor G. E. Hale, from the Yerkes Observatory, reports that from photographs of Nova Persei on November 9 Ritchey finds the nebula probably expanding in all directions, this certainly being true of the southern half.

AN international sanitary congress will be held in Paris during the week of February 15–21, 1902. Among the subjects to be discussed will be the rôle of mosquitoes in the spread of yellow fever, malaria and filariasis, quarantine, and the value of municipal sanitation in the prevention of epidemics.

THE Institution of Junior Engineers opened its winter session on November 1, at the Westminster Palace Hotel. The new President, Sir John Jackson, was installed, and delivered his inaugural address, in which he dealt chiefly with the relations between employers and employed.

THE biennial dinner of the Physical Society of London will be held at the Hotel Cecil on Friday, November 15.

WE learn from the *Journal of the American Medical Society* that it is proposed to unite the scientific institutes at Hamburg under one direction, somewhat in the form of a university, and the directors and lecturers will compose the faculty, issue reports, etc. The official title of the faculty will be the 'Professorenconvent' of the Scientific Institutes. Besides promoting individual research, the institutes will carry on research desired by men of science and advise in scientific matters generally.

PREPARATIONS are being made for the despatch of a new Norwegian expedition to determine more exactly the position of the north magnetic pole. The expedition will be under the direction of M. Amundsen, a Norwegian, who was one of the officers in M. Gerlache's Antarctic expedition.

A CABLEGRAM to the New York *Sun* states that a striking discovery has been made during

excavations which were necessary to raise one of the monoliths in the famous prehistoric group at Stonehenge in Wiltshire into an upright position. The men engaged in the work have found numerous neolithic implements, which had evidently been used in cutting and squaring the stones, and, when blunted, had been turned into the bedding on which the stones are supported. The discovery is held to prove that the unique spectacle of Stonehenge is anterior to the Bronze Age and that the structure still visible was certainly built before 1500 B. C.

FOREIGN journals give particulars respecting a new meteorological station which has been established at Achariach, in Glen Nevis, Scotland. The situation is such that a spur of Ben Nevis shuts in the valley to the west, and the height above sea-level is only 165 feet. The intention of the founder of the station—Mr. R. C. Mossman of Edinburgh—is 'to study the thermal conditions in the valley and on the adjacent hillsides during anticyclones in winter.' It seems that in calm, cold weather and with a high barometer it not seldom happens that the mountain summits are much warmer than the valleys which are filled with cold air chilled by radiation from the surrounding hills. The height to which this lake of cold air extends is to be the principal subject of investigation. The station is well equipped with a complete set of the best instruments.

THE London *Times* calls attention to the fact that the late M. I. C. Jacobsen presented to the State or spent for scientific or philanthropic purposes nearly 20,000,000 kroner. He created the 'Carlsberg Fund,' which now amounts to 12,500,000 kroner and recently celebrated the 25th anniversary of its foundation. On this occasion his son, M. Carl Jacobsen, has added as a donation his own brewery, only reserving for himself and his family one third of the income for fifty years. The value of this gift is calculated at 10,000,000 kroner. M. Carl Jacobsen two years ago presented Copenhagen with what was certainly the largest private collection of sculptures in the world—its value being 12,000,000 kroner—and with many other large donations.

WE learn from the *Auk* that the large collection of birds' eggs, nests and skins brought together by Miss Jean Bell, of Ridley Park, Pa., has been purchased by Mr. John Lewis Childs, of Floral Park, New York. It is said to contain about 30,000 eggs and 1,000 nests, and is reported to be one of the finest and most complete private collections of North American birds' eggs extant. It includes many rarities, and is rich in large sets of comparatively rare species, the collection having been formed through the combination of several noteworthy private collections.

THE program for the forthcoming session of the Royal Geographical Society of London is announced as follows: At the opening meeting, on November 11, Sir Harry Johnston proposed to give a paper on Uganda and the bordering countries, through which he made several journeys in his capacity as special commissioner. Not only will the paper be illustrated by a large number of slides, including a colored one of the Okapi, but Sir Harry will give phonographic reproductions of the songs of the natives. At the second meeting, on November 25, the president, Sir Clements Markham, will give a short opening address, and he will follow that with a paper on King Alfred and the geography of his time. During the evening Dr. Vaughan Cornish will give an extremely interesting cinematographic representation of the Bore of the Severn. The paper at the meeting on December 9 will be by Mr. Douglas Freshfield, on the 'Glaciers of Kauchinjunga,' the results of his recent expedition to that vastly interesting region; it will be illustrated by many lantern slides, mainly from photographs taken by Signor Sella, who accompanied the expedition. Among the papers to be expected after Christmas are the following: 'An Expedition across Abyssinia, through Kaffa and the Region to the West and North,' by Dr. Oscar Neumann; the 'Maldives,' by Mr. J. Stanley Gardiner; 'Journeys in Western China,' by Dr. R. L. Jack; 'The Influence of Geographical Conditions on History and Religion, with Special Reference to Asia Minor,' by Professor W. M. Ramsay; 'Four Years' Travel and Survey in Persia,' by Major Molesworth Sykes; 'An Expedition from Omdur-

man to Mombasa by Lake Rudolf,' by Major H. H. Austin; 'Southwards on the Antarctic Ship *Discovery*,' by Mr. George Murray, F.R.S., and Dr. Hugh Robert Mill; 'A Journey from Quetta to Meshed by the New Nushki Trade Route,' by the Earl of Ronaldshay; 'The Bedford Level and Experimental Demonstration of the Rotundity of the Earth,' by Mr. H. Yule Oldham; 'The Snows of Canada,' by Mr. Vaughan Cornish; 'Antarctic Glaciation,' by M. Henryk Arçtowski, and 'Methods and Appliances in the Teaching of Geography,' a special lecture for teachers, by Mr. A. W. Andrews. The paper by M. Arçtowski will be given at an afternoon meeting, while Mr. Andrews's lecture will be given at a special meeting on a date and at an hour likely to be convenient to teachers in and around London.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. WILLIAM WYMAN announces that $750,000 has been raised of the $1,000,000 necessary to make available his offer to the Johns Hopkins University of 60 acres of land in the Northern Annex. Mr. William Keyser gave $200,000 of the amount. The names of all the contributors to the fund will not, however, be announced until it is complete.

KENYON COLLEGE has received from various sources $100,000 towards its endowment and $50,000 for a new dormitory.

AN industrial college for women, to be called The Simmons Female College, will be shortly established in Boston, in accordance with a bequest made by John Simmons in 1875. The estate, which was subject to a life interest, now amounts to over $2,000,000.

MR. B. F. BARGE, B.A. (Yale '57), has added $2,500, to the same sum given by him recently to Yale University. The money is to endow a mathematical fund.

BY the will of the late E. P. Barker, Amherst College and Alfred University each receive $1,000.

MR. and MRS. E. C. THOMPSON, of Indianapolis have added $20,000 to the $10,000 previously given by them to Butler College in that city, for the construction of the Bona Thompson Library, as a memorial to their daughter.

MR. B. A. PALMER, of New York, has made a gift of $30,000 to Union Christian College, Merom, Ind.

DRURY COLLEGE, at Springfield, has received $8,000 from E. A. Goodnow, Esq., of Worcester, Mass., for scholarships for young women.

THE Duke of Sutherland has decided to erect a large technical school near Golspie, Sutherland. Building and equipment will cost £10,000, and in order to place the institution in an independent position it is said that Mr. Carnegie has offered another £10,000 as an endowment.

MRS. FITZPATRICK has given £2,000 to found a lectureship on the history of medicine, in the Royal College of Physicians, London, in memory of her late husband, Dr. Thomas FitzPatrick.

THE Horace Mann school building of Teachers College, Columbia University, will be dedicated on December 5. The principal address will be by ex-President Daniel C. Gilman, of the Johns Hopkins University.

EDWARD P. HYDE, A.M. (Johns Hopkins, 1900), has been given a fellowship in physics in the Johns Hopkins University.

MR. R. P. PARANJPYE, who was bracketed senior wrangler in 1899, has been elected to a fellowship at St. John's College.

DR. HANS SOLEREDER, of Munich, has been appointed professor of botany and director of the Botanical Institute at the University at Erlangen. Dr. V. Schiffner, associate professor of systematic botany in the German University at Prague, has been called to a similar position in the University of Munich. A full professorship of astronomy in the University of Göttingen has been offered to Dr. Karl Schwarzschild, docent at Munich. Dr. G. Kowalewski, docent in mathematics at Leipzig, has been called to an associate professorship in the University at Greifswald, and Dr. Julius Sommer, docent at Göttingen has been appointed professor of mathematics in the Agricultural School at Bonn-Poppelsdorf.